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Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-14-132

August 28, 2014

10 CFR 2.202
10 CFR 50.4

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Browns Ferry Nuclear Plant, Units 1, 2, and 3
Facility Operating License Nos. DPR-33, DPR-52, and DPR-68
NRC Docket Nos. 50-259, 50-260, and 50-296

Subject: **Third Six-Month Status Report and Revised Overall Integrated Plan in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant (TAC Nos. MF0902, MF0903, and MF0904)**

References:

1. NRC Order Number EA-12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ML12054A735)

2. NRC Interim Staff Guidance JLD-ISG-2012-01, "Compliance with Order EA-12- 049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," Revision 0, dated August 29, 2012 (ML12229A174)

3. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide," Revision 0, dated August 2012 (ML12242A378)

4. Letter from TVA to NRC, "Tennessee Valley Authority (TVA) - Initial Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049)," dated October 29, 2012 (ML12307A104)

5. Letter from TVA to NRC, "Tennessee Valley Authority (TVA) - Overall Integrated Plan in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant," dated February 28, 2013 (ML13064A465)

6. Letter from TVA to NRC, "First Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant," dated August 28, 2013 (ML13247A284)

7. Letter from NRC to TVA, "Browns Ferry Nuclear Plant, Units 1, 2, and 3 – Interim Staff Evaluation Relating to Overall Integrated Plan in Response to Order EA-12-049 (Mitigation Strategies) (TAC Nos. MF0902, MF0903, and MF0904)," dated December 19, 2013 (ML13353A166)

8. Letter from TVA to NRC, "Second Six-Month Status Report in Response to the March 12, 2012, Commission Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events (Order Number EA-12-049) for Browns Ferry Nuclear Plant (TAC Nos. MF0902, MF0903, and MF0904)," dated February 28, 2014 (ML14064A240)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued an order (Reference 1) to Tennessee Valley Authority (TVA). Reference 1 was immediately effective and directed TVA to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities following a beyond-design-basis external event. Specific requirements are outlined in Attachment 2 of Reference 1.

Reference 1 required submission of an initial status report 60 days following issuance of the final interim staff guidance (Reference 2) and an overall integrated plan pursuant to Section IV, Condition C. Reference 2 endorses industry guidance document Nuclear Energy Institute (NEI) 12-06, Revision 0 (Reference 3) with clarifications and exceptions identified in Reference 2. Reference 4 provided the TVA initial status report regarding mitigation strategies. Reference 5 provided the TVA Browns Ferry Nuclear Plant, Units 1, 2, and 3 overall integrated plan.

Reference 1 requires submission of a status report at six-month intervals following submittal of the overall integrated plan. Reference 3 provides direction regarding the content of the status reports. TVA provided the first six-month status report on August 28, 2013 (Reference 6). The NRC issued its Interim Staff Evaluation regarding TVA's overall integrated plan on December 19, 2013 (Reference 7). TVA submitted its second six-month status report on February 28, 2014 (Reference 8).

In Section 7 to the Enclosure of Reference 8, it was noted that TVA was evaluating potential changes to the capacity and storage options of the current 3 MW FLEX diesels and the potential need for relief regarding Order EA-12-049 FLEX/Order EA-13-109 containment venting interface. Reference 8 also noted any changes to the BFN mitigation strategies resulting from this review would be provided to the NRC in the third six-month status report.

The purpose of this letter is to provide the third six-month status report pursuant to Section IV, Condition C.2, of Reference 1, that delineates progress made in implementing the requirements of Reference 1, including the resulting changes to the capacity and storage options of the current 3 MW FLEX diesels. Specifically, the Enclosure of this letter provides a revised Overall Integrated Plan (OIP) and it replaces the OIP submitted in Reference 2 in its entirety. Revision 1 of the OIP incorporates the following changes from Revision 0.

- Use of pre-staged 225kva and 3MW diesel generators has been revised to use of portable 850kw and 1.1MW generators stored in the FLEX Equipment Storage Building (FESB);
- Revision to the following strategies due to change from pre-staged 225kva and 3 MW diesel generators to portable 850kw and 1.1MW generators:
    - electrical connection strategies,
    - load shed strategies,
    - FLEX generator re-fueling and staging strategies,
    - Phase 2 spent fuel pool makeup strategy; and,
    - Sequence of Events;
- Use of Residual Heat Removal (RHR) system for decay heat removal has been revised to use of hardened wetwell vent as primary strategy to provide containment cooling; and,
- Incorporation of changes noted in the first and second 6-month status reports submitted in References 6 and 8.

In addition to the changes described above, the Open Items table in the Enclosure has been updated. The milestone target completion dates have also been updated as shown in Attachment 2 of the Enclosure.

Because the wetwell vent will be used as the primary strategy to provide containment cooling, TVA has determined that relief regarding Order EA-12-049 FLEX and Order EA-13-109 containment venting interface is needed. TVA is submitting, under separate letter, a Request for Relaxation from NRC Order EA-12-049 in parallel with this six-month status report. TVA's Request for Relaxation follows previously submitted Boiling Water Reactor industry precedents.

The Enclosure describes the plans that TVA will use to meet the regulatory requirements outlined in Attachment 2 of Reference 1, but does not identify any additional actions to be taken by TVA. Therefore, this letter contains no regulatory commitments.

If you have any question regarding this submittal, please contact Kevin Casey at (423) 751-8523.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 28th day of August 2014.

Respectfully,

J. W. Shea

Digitally signed by J. W. Shea
DN: cn=J. W. Shea, o=Tennessee Valley Authority, ou=Nuclear Licensing, email=jwshea@tva.gov, c=US
Date: 2014.08.28 20:05:42 -04'00'

J. W. Shea
Vice President, Nuclear Licensing

Enclosure:

Tennessee Valley Authority Browns Ferry Nuclear Plant, Mitigation Strategies for Beyond-Design-Basis External Events Overall Integrated Plan, Revision 1

cc (Enclosure):

NRR Director - NRC Headquarters
NRO Director - NRC Headquarters
NRR JLD Director - NRC Headquarters
NRC Regional Administrator - Region II
NRC Project Manager - Browns Ferry Nuclear Plant
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

ENCLOSURE

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT

MITIGATION STRATEGIES FOR BEYOND-DESIGN-BASIS EXTERNAL EVENTS
OVERALL INTEGRATED PLAN
REVISION 1

General Integrated Plan Elements (PWR & BWR)

(Section 1) Determine Applicable Extreme External Hazard **Ref: NEI 12-06, section 4.0 -9.0** **JLD-ISG-2012-01, section 1.0**	*Input the hazards applicable to the site; seismic, external flood, high winds, snow, ice, cold, high temps.* *Describe how NEI 12-06 sections 5 – 9 were applied and the basis for why the plant screened out for certain hazards.*

The Browns Ferry Nuclear Plant (BFNP) site has been evaluated using the Nuclear Energy Institute (NEI) Flexible and Diverse Coping Mitigation Strategies (FLEX) guidance and the following applicable hazards have been identified:

- seismic events,
- external flooding,
- storms with high winds and tornadoes,
- snow, ice, extreme cold and
- extreme heat.

Browns Ferry Nuclear Plant has determined the functional threats from each of these hazards and identified FLEX equipment that may be affected. The FLEX equipment and FLEX strategies consider the impacts of the applicable external hazards and will address protection and deployment of FLEX equipment, procedural interfaces, and utilization of on-site and off-site resources.

Seismic Hazard Assessment

Per NEI 12-06, seismic hazards must be considered for all nuclear sites. As a result, the credited FLEX equipment will be assessed based on current BFNP seismic licensing basis to ensure that the equipment remains accessible and available after a Beyond-Design-Basis External Event (BDBEE) and that the FLEX equipment does not become a target or source of a seismic interaction from other systems, structures, or components (Open Item, OI 9). Per the BFNP Units 1, 2, and 3 Updated Final Safety Analysis Reports (UFSAR) section 2.5 (Ref. 1d) for a Design Basis Earthquake (DBE) / Safe Shutdown Earthquake (SSE) the maximum rock acceleration requirements are 0.2g horizontal and 0.133g vertical. For an Operating Basis Earthquake (OBE), the maximum horizontal and vertical ground accelerations are 0.1g and 0.067g. The FLEX strategies developed for BFNP will include documentation ensuring that any storage locations and deployment routes meet the FLEX seismic criteria (Open Item, OI 14).

Liquefaction

The liquefaction potential of FLEX deployment routes from Staging area “B” to Staging Area “A,” refer to Attachment 3 – Figure 5 for conceptual sketch of staging areas that will be evaluated in a future assessment (Open Item, OI 2). An evaluation will be performed of the route(s) from Staging Area “D” and Staging Area “C” to Staging Area “B” (Open Item, OI 2).

Internal Flooding

Abnormal operating procedure, AOI-100-9, Turbine Building Internal Flooding, provides the symptoms and operator actions to be taken for this condition. During development of procedures to support FLEX strategies, adequate guidance will be given to operators to ensure their travel paths avoid these areas. (OI 21)

External Flooding Hazard Assessment

Browns Ferry Nuclear Plant is susceptible to flooding via two sources:

- local intense precipitation and
- river flooding.

The Probable Maximum Flood (PMF) will reach a maximum still-water elevation of 572.5', per UFSAR section 2.4A (Ref. 1c). A maximum flood elevation of 578' at BFNP results from a combination of the PMF and wind wave run-up on a vertical wall per UFSAR (Ref. 1c). Plant grade is at elevation 565’ and Browns Ferry Nuclear Plant structures, located in the flood plain which house equipment important to safety are designed to remain watertight by utilizing both permanently installed and temporary barriers (“wet site”). The maximum duration flood at BFNP lasts 10.5 days above plant grade and reaches a maximum still water elevation of 569.2 feet. The FLEX strategies developed for BFNP will ensure that any storage locations, deployment routes, and connection points meet the FLEX flooding criteria, are at an elevation not susceptible to flooding (except for those strategy elements not credited for flooding) or deployment and connection is completed during the timeframe from level rising from elevation 558’ to 565’ (approximately 5 days). In addition, BFNP is also developing procedures and strategies for delivery of offsite FLEX equipment during Phase 3 which considers regional impacts from flooding (Open Item, OI 14).

Storms with High Winds and Tornadoes Hazards Assessment

NEI 12-06 Figures 7-1 and 7-2 were used for this assessment.

Browns Ferry Nuclear Plant is susceptible to hurricanes, as the plant is within the contour lines shown in NEI 12-06 Figure 7-1 (Ref. 3a).

It was determined that BFNP site has the potential to experience damaging winds caused by tornado exceeding 130 mph. Figure 7-2 of NEI 12-06 indicates a maximum wind speed of 200 mph for Region 1 plants, including BFNP. Therefore, high-wind hazards are applicable to BFNP. It should be noted that BFNP was designed to 300 mph wind loads.

In summary, based on available local data and NEI 12-06 Figures 7-1 and 7-2 (Ref. 3a & 3b) BFNP is susceptible to severe storms with high winds so the hazard is considered to be credible.

Snow, Ice, and Extreme Cold Hazards Assessment

Per NEI 12-06 (Ref. 3) all sites should consider the temperature ranges and weather conditions for their site in storing and deploying their FLEX equipment. Equipment procured should be suitable for use in the anticipated range of conditions for the site, consistent with normal design practices.

(Section 1) Determine Applicable Extreme External Hazard

Ref: NEI 12-06, section 4.0 -9.0
JLD-ISG-2012-01, section 1.0

Applicability of snow and extreme cold

As depicted in NEI 12-06 Figure 8-1 (Ref. 3c) for plants located below the 35th parallel, snow and extreme cold events are unlikely to present a significant problem for deployment of FLEX. Browns Ferry Nuclear Plant is below the 35th parallel; however, based on historical data collected from both NEI 12-06 Figure 8-1 (Ref. 3c) and the BFNP UFSAR, snowfalls in excess of 6 inches have occurred in the past. Browns Ferry Nuclear Plant UFSAR section 2.3.5.3 (Ref. 1b) references snowfall reports of 17.1, 10.1, and 10.0 inches near BFNP. Per UFSAR section 2.3.5.1 (Ref. 1a), in a typical year, Decatur, Alabama (located approximately 10 miles southeast of BFNP) has approximately 57 days per year with minimum temperatures equal to or less than 32°F with an extreme daily temperature record of -12°F. Therefore, the FLEX strategies will consider the challenges caused by extreme snowfall and extremely cold temperatures.

Applicability of ice storms

Browns Ferry Nuclear Plant is located in either ice severity level 4 or 5 region, defined by NEI 12-06 Figure 8-2 (Ref. 3d). Browns Ferry Nuclear Plant FLEX strategies will consider impedances caused by ice storms.

In summary, based on the available local data and NEI 12-06, Figures 8-1 and 8-2 (Ref. 3c & 3d) BFNP does experience significant amounts of snow, ice, and extreme cold temperatures; therefore, the hazards are considered to be credible.

Extreme Heat

Per NEI 12-06 (Ref. 3) all sites must address high temperatures. Virtually every state in the lower 48 contiguous United States has experienced temperatures in excess of 110°F. Many states have experienced temperatures in excess of 120°F. Per the UFSAR section 2.3.5.1, in a typical year, Decatur, Alabama (located approximately 10 miles southeast of BFNP) has approximately 70 days per year with maximum temperatures equal to or greater than 90°F, with an extreme daily temperature record of 108°F.

Selection of BFNP FLEX equipment will consider the site maximum expected temperatures in their specification, storage, and deployment requirements, including adequate ventilation or supplementary cooling, as required.

(Section 1) Determine Applicable Extreme External Hazard **Ref: NEI 12-06, section 4.0 -9.0** **JLD-ISG-2012-01, section 1.0**
References: 1. Browns Ferry Nuclear Plant (BFNP) Updated Final Safety Analysis Report (UFSAR) a. Section 2.3.5.1 b. Section 2.3.5.3 c. Section 2.4 d. Section 2.5 2. Draft Interim Staff Guidance JLD-ISG-2012-01, Compliance with Order EA-12-049, “Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond-Design-Basis External Events”; Docket ID NRC-2012-0068 3. NEI 12-06, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide” a. Figure 7-1 b. Figure 7-2 c. Figure 8-1 d. Figure 8-2 4. BFN calculation CDQ000020080054 Rev. 4, Nuclear PMF Determination for Tennessee River Watershed
Notes: None

(Section 2) Key Site assumptions to implement NEI 12-06 strategies. **Ref: NEI 12-06, section 3.2.1**	*Provide key assumptions associated with implementation of FLEX Strategies:* • *Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 are not completed and therefore, not assumed in this submittal. As the re-evaluations are completed, appropriate issues will be entered into the corrective action system and addressed on a schedule commensurate with other licensing bases changes.* • *Exceptions for the site security plan or other (license/site specific) requirements of 10CFR may be required.* • *Deployment resources are assumed to begin arriving at hour 6 and fully staffed by 24 hours.* • *Certain Technical Specifications cannot be complied with during FLEX implementation.*

Key assumptions associated with implementation of Flexible and Diverse Coping Mitigation Strategies (FLEX) Strategies for Browns Ferry Nuclear Plant (BFNP) are described below:

Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 (Ref. 1) are not completed and therefore, not assumed in this submittal. As the re-evaluations are completed, appropriate issues will be entered into the corrective action program and addressed on a schedule commensurate with other licensing bases changes. (Open Item, OI 1).

- The following conditions exist for the baseline case:
    - Seismically designed DC battery banks are available;
    - Seismically designed AC and DC distribution panels are available;
    - Plant initial response is the same as for Station Blackout (SBO);
    - Best estimate analysis and decay heat is used to establish requirements for operator time and action;
    - System, Structure, or Component (SSC) failures that are random or due to causes beyond those stipulated in the Order are not assumed.
- Margin will be added to design FLEX components and hard connection points to address future requirements as re-evaluation warrants. Portable FLEX components will be procured commercially.
- The design hardened connections shall be protected against external events or are established at multiple and diverse locations.
- Deployment strategies and deployment routes are assessed for impact due to identified hazards (Open Item, OI 14).
- Phase 2 FLEX components are stored at the site and available after the event they are designed to mitigate.

(Section 2) Key Site assumptions to implement NEI 12-06 strategies.

Ref: NEI 12-06, section 3.2.1

- Additional staff resources are expected to begin arriving at 6 hours and the site will be fully staffed 24 hours after the event. (Ref. 2)
- Exceptions for the site security plan or other (license/site specific) requirements may be identified during the design process. These exceptions will be processed when they are identified.
- FLEX assumes that:
  (1) On-site staff are at site administrative minimum shift staffing levels (minimum staffing may include additional staffing that is procedurally brought on-site in advance of a predicted external event, e.g., hurricane or flood);
  (2) There are no independent, concurrent events, e.g., no active security threat;
  (3) All personnel on-site are available to support site response (including Security, etc.).

  The normal emergency response capabilities are augmented by NEI 12-01 (Ref. 4). Staffing will continue to be developed further as the design phase for FLEX progresses. (Open Item, OI 15)
- Though specific strategies are being developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions. These pre-planned strategies developed to protect the public health and safety will be incorporated into the unit Operating Procedures in accordance with established procedure change processes, and their impact to the design basis capabilities of the unit evaluated under 10 CFR 50.59. (Open Item, OI 17) The plant Technical Specifications contain the limiting conditions for normal unit operations to ensure that design safety features are available to respond to a design basis accident and direct the required actions to be taken when the limiting conditions are not met. Per Final Response to Task Interface Agreement (TIA) 2004-04 (Ref. 3) the result of the beyond-design-basis event may place the plant in a condition where it cannot comply with certain Technical Specifications, and as such, may warrant invocation of 10 CFR 50.54(x) and/or 10 CFR 73.55(p).

(Section 2) Key Site assumptions to implement NEI 12-06 strategies. **Ref: NEI 12-06, section 3.2.1**
References: 1. 10 CFR 50.54(f) 2. BWR Owners' Group – "Emergency Procedure and Severe Accident Guidelines", Revision 3 (February 2013) 3. Final Response to Task Interface Agreement (TIA) 2004-04, "Acceptability of Proceduralized Departures from Technical Specifications (TSs) Requirements at the Surry Power Station, (TAC Nos. MC4331 and MC4332)," dated September 12, 2006 (Accession No. ML060590273) 4. NEI 12-01, "Guideline for Assessing Beyond-Design-Basis Accident Response Staffing and Communications Capabilities" 5. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"
Notes: None

Section 3) Extent to which the guidance, JLD-ISG-2012-01 and NEI 12-06, are being followed. **Identify any deviations to JLD-ISG-2012-01 and NEI 12-06.** **Ref: JLD-ISG-2012-01** **NEI 12-06, section 13.1**	*Include a description of any alternatives to the guidance, and provide a milestone schedule of planned action.*

Browns Ferry Nuclear Plant has no known deviations to the guidelines in JLD-ISG-2012-01 (Ref. 1) and NEI 12-06 (Ref. 2). If deviations are identified, then the deviations will be communicated in a future "6 month update" following identification.

References:

1. Draft Interim Staff Guidance JLD-ISG-2012-01, Compliance with Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond-Design-Basis External Events"; Docket ID NRC-2012-0068
2. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"

Notes:

None

(Section 4) Provide a sequence of events and identify any time constraint required for success including the technical basis for the time constraint. **Ref: NEI 12-06, section 3.2.1.7** **JLD-ISG-2012-01, section 2.1**	*Strategies that have a time constraint to be successful should be identified with a technical basis and a justification provided that the time can reasonably be met (for example, a walkthrough of deployment).* *Describe in detail in this section the technical basis for the time constraint identified on the sequence of events timeline Attachment 1A* *See attached sequence of events timeline (Attachment 1A).* *Technical Basis Support information, see attached NSSS Significant Reference Analysis Deviation Table (Attachment 1B)*

Discussion of time constraints identified in Attachment 1A table.

Items 1-3: For floods, plant shutdown begins when river level reaches 558', and it is predicted to exceed elevation 565', per Abnormal Operating Instruction, 0-AOI-100-3 (Ref 1b). This is more than 5 days before flood waters would reach plant grade level (565', based on UFSAR Section 2.4 Ref. 3a). Deployment of Flexible and Diverse Coping Mitigation Strategies (FLEX) Pumping Systems must be complete before flood waters reach the transport path, which shall be at plant grade or higher. FLEX pumps have been estimated to be deployed within 6 hours by walkthrough, 480v Flex DG has been estimated to be deployed within 6 hours by tabletop demonstration and 4kv Flex Support DG have been estimated to be deployed within 12 hours (to be confirmed during the design/staffing evaluation process). A Design Basis Flood (DBF) would not reach the maximum flood height (elevation 572') for which Emergency Core Cooling System (ECCS) equipment is qualified for at least another 72 hours based on the Updated Final Safety Analysis Report (UFSAR) estimate above (Ref. 3a). Start-up of the 4 kV FLEX Support DGs and 480 V FLEX Generators can be performed after the normal emergency generators are lost.

Item 4: DBF level is reached. (Peak elevation and timing based on UFSAR Section 2.4, Figure 16 (Ref. 3ai)).

Item 5: Phase 1 commences when ELAP & loss of the UHS occur. All 3 units are assumed to have been operating at 100 percent rated thermal power for at least 100 days or have just been shut down from such a power history as required by plant procedures in advance of the impending event. For floods, FLEX deployment would have already been complete and the units would be at cold shutdown.

Item 6: Normal plant response to loss of offsite power.

Item 7: Normal plant response to loss of offsite and onsite AC power (Station Blackout, SBO)

Item 8: RPV depressurization starts at 20 minutes at a rate up to 100°F/hr in accordance with site procedures.

Reactor Pressure Vessel (RPV) controlled depressurization will be governed by new BWROG Emergency Procedure Guideline (EPG) guidance (Ref. 5 and 7). Based on the modeling in the evaluation, plant systems were demonstrated to support requirements for core cooling, and containment integrity. Since Operators will still be in the design basis SBO procedures, the SBO procedures must also stipulate this depressurization until the conditions for exiting the design basis SBO procedures are met. Main Steam Relief Valve (MSRV) control is maintained from the control room with sufficient DC power and pneumatic pressure to operate the MSRVs throughout Phase 1 and Phase 2 (if required). According to GEH studies (Ref. 7), the MSRV pilot solenoid coil electrical resistance will increase due to a higher containment temperature with a longer duration event than an existing SBO coping time. Browns Ferry Nuclear Plant will evaluate MSRV qualification against the predicted containment response with FLEX implementation to ensure there will be sufficient DC bus voltage during the Extended Loss of AC Power (ELAP) event (Open Item, OI 4). If required, there will be a modification to increase voltage as necessary to achieve the necessary coil current, or modifications will be made to reduce the coil resistance under higher temperature conditions. Because the MSRV control system will be exhausting control gas to the containment and containment pressure will be higher, BFNP is evaluating methods to establish any required increases in pneumatic supply pressure and modifications that may be required to ensure a supply of control gas for the MSRVs over the longer ELAP interval.

Item 9: Dispatch personnel to start deployment of the applicable Diesel Driven FLEX Pumping Systems. (Note: these pumps will have already been deployed for a DBF (see Item 2). Direction to deploy the FLEX Pumping Systems will be contained in site procedures.

Item 10: Dispatch personnel to start deployment of the 480v FLEX DG. (Note: the 480v FLEX DG will have already been deployed for a flood event (see Item 2). Direction to deploy the 480v FLEX Generators will be contained in site procedures.

Item 11: $\leq$ 1 hour, Entry into ELAP - *Time critical at a time greater than 1 hour*. A period of one hour is selected conservatively to ensure that ELAP entry conditions can be verified by control room staff and it is validated that Emergency Diesel Generators (EDGs) are not available. One hour is a reasonable assumption for Operators to perform initial evaluation of the EDGs. Entry into ELAP provides guidance to Operators to perform ELAP actions. A formal validation of the timeline will be performed once the procedure guidance is developed and related staffing study is completed (Open Item, OI 15, 16).

Cooldown is continued to a final pressure of approximately 150 psig to 250 psig (Cooldown will be complete for flood events)

Item 12: New procedure guidance is to be developed as part of the FSGs. Initial load shedding must be complete by T+4 to extend battery capability to 12 hours (Ref. 2).

A table top evaluation was performed by site personnel to obtain a one hour estimate, leaving a margin of one hour (before T+4). A formal validation of the timeline will be performed once the procedure guidance is developed and related staffing study is completed (Open Item, OI 15, 16). The breakers to be operated are in the control bay in normally accessible areas and will be marked for ready identification during ELAP conditions.

The locations to implement shallow load shed are in the following rooms:

- Control Bay - Battery Board Rm 1 - El 593',
- Control Bay - Battery Board Rm 2 - El 593',
- Control Bay - Battery Board Rm 3 - El 593',
- Control Bay - 250 V DC Reactor MOV Board 1A - El 621',
- Control Bay - 250 V DC Reactor MOV Board 2A - El 621',
- Control Bay - 250 V DC Reactor MOV Board 3A - El 621',
- Control Bay - 250 V DC Reactor MOV Board 1B - El 593 ,
- Control Bay - 250 V DC Reactor MOV Board 2B - El 593'.

Item 13: At T+>2 hours - At the expected cooldown rate the RPV is being maintained above 150 psig.

Item 14: At T+≤4 hours – Initial DC load shedding is complete.

Item 15: Use of the Torus vent would only be in accordance with Generic Letter 89-16 (preliminary MAAP analysis under evaluation); due to rescinding of NRC Order EA-12-050 and issuance of NRC Order 13-109. The currently installed hardened Torus vent is only designed to vent a single reactor unit and any changes to the system will be driven and in compliance with NRC Order EA-13-109. TVA will transmit a request for relaxation of full compliance with NRC Order EA-12-049 until a severe accident capable vent is installed in accordance with NRC Orde EA13-109. The hardened wetwell vent was installed in accordance with Generic Letter 89-16, "Installation of a Hardened Wetwell Vent". BFN will rely on the existing Torus venting capabilities in the interim.

Item 16: 480v FLEX generator is deployed and connected to the safety related battery charger for each unit. Battery charging commences.

Item 17: A tabletop and pump demonstration indicates this can be complete in 8 hours, beginning with the SBO. Crews have done an exercise to install and pump with the low pressure FLEX pumps; however, the augmented suction lift for extreme low lake level has not yet been practiced. *Further evaluations and improvements will be pursued and it is anticipated that the deployment time can be reduced to 6 hours.* Formal validation of the timeline will be performed once procedural guidance is developed and the related staffing study is complete.

Item 18: EECW aligned to RCIC oil cooler (requires modification) before temperature is in far excess of 240 degrees F. EECW is supplied by FPS1.

Item 19: With access to the Ultimate Heat Sink (UHS) established via FLEX low pressure diesel driven pumps, the reactor depressurization may be commenced. This will be a decision point contained within new procedures; that will allow the Shift Manager / Site Emergency Director to evaluate reliability of the RCIC system and direct injection with the FLEX Pumping Systems as deemed appropriate.

Item 20: 4kv FLEX Support Generators are deployed and connected. The 4kv safety related distribution system is available for service.

Item 21: Sustained coping will be supported by maintaining FLEX equipment fuel and in service.

Item 22: Add water to the SFP from the river using FLEX Pumping System, FPS1 through either the connection to the condensate storage and supply system or through the EECW supply line for emergency SFP makeup.. This will be done if it is not possible to establish makeup from FPS2 or FPS3 via the RHR supplemental fuel pool cooling / makeup lineup.

This is done if necessary to maintain the fuel in the pool submerged sufficiently to prevent damage and to provide adequate shielding. The SFP need not be maintained at normal water level and additional FLEX guidance will be developed using the systems from Order EA 12-051 (Ref. 11) (Open Item, OI 12). If the evaporation rate from the SFP is very high, it will be because the unit has just returned to service from a refueling outage.

Item 23: The industry will establish two Regional Response Centers (RRC) in order to support utilities during beyond-design-basis events. Flex equipment will be stored at staging are “B”. Fuel support for FLEX equipment will be provided after the first 24 hours in accordance with the TVA playbook (the Regional Response Center’s plan for coordinating with each utility). TVA will have enough diesel fuel onsite for the first 24 hours (Open Item, OI 3).

Item 24: <u>Sargent and Lundy Study: Loss of HVAC During ELAP</u> (Ref. 12) specifies manual actions to ensure acceptable hydrogen limits in the battery rooms. A formal validation of the timeline will be performed once the procedure guidance is developed and related staffing study is complete (Open Item, OI 15, 16).

Item 25: <u>Sargent and Lundy Study: Loss of HVAC During ELAP</u> (Ref. 12) specifies manual actions needed to ensure acceptable room temperatures. A formal validation of the timeline will be performed once the procedure guidance is developed and related staffing study is complete (Open Item, OI 15, 16).

<u>Technical Basis Support information</u>

1. On behalf of the Boiling Water Reactor Owners Group (BWROG), GEH Evaluation of FLEX Implementation Guidelines, NEDC-33771P, Revision 0 (Ref. 7) to supplement the guidance in NEI 12-06 (Ref. 9) by providing additional Boiling Water Reactor (BWR)-specific information regarding the individual plant response to the ELAP and Loss of Ultimate Heat Sink (LUHS) events. The document includes identification of the generic event scenario and expected plant response, the associated analytical bases and recommended actions for performance of a site-specific gap analysis.

   GEH Evaluation (Ref. 7) utilized the NRC accepted SUPERHEX (SHEX) computer code methodology for BWR’s long term containment analysis for the ELAP analysis. As part of this document, a generic BWR 4/Mark I containment NSSS evaluation was performed. TVA utilized this generic evaluation as appropriate to develop coping strategies.

2. Environmental conditions within the station areas were evaluated utilizing Thermal Model Generator Methods (TMG).
3. Per the guidance in 10 CFR 50.63 and Regulatory Guide 1.155 BFNP is an alternate AC, four hour coping plant for Station Blackout (SBO) considerations. Applicable portions of supporting analysis have been used in ELAP evaluations as starting points for the evaluations performed to meet the guidance from NEI 12-06 (Ref. 9).

(Section 4) Provide a sequence of events and identify any time constraint required for success including the technical basis for the time constraint.

Ref: NEI 12-06, section 3.2.1.7
JLD-ISG-2012-01, section 2.1

<u>References:</u>

1. Abnormal Operating Instructions (AOIs)
   a. 0-AOI-100-3, Flood Above Elevation 558'
2. AREVA Engineering Information Record Document No.: 51-9198045-000, "Browns Ferry Post Fukushima FLEX Response Evaluation"
3. Browns Ferry Nuclear Plant (BFNP) Updated Final Safety Analysis Report (UFSAR) Revision 31, 11/12
   a. Section 2.4A
      i. Figure 16 (Amendment 25)
   b. Section 14.6
      i. Figure 11 (Amendment 16)
4. BFNP Emergency Operating Instruction (EOI) Program Manuals
5. BWR Owners' Group – "Emergency Procedure and Severe Accident Guidelines", Revision 3 (February 2013)
6. Emergency Operating Instructions (EOIs)
   a. EOI-1 (Units 1, 2, and 3)
   b. EOI-2 (Units 1, 2, and 3)
   c. EOI-3 (Units 1, 2, and 3)
7. "GEH Evaluation of FLEX Implementation Guidelines", NEDC-33771P, Revision 0
8. MAAP Analysis (William Z. Mims, Jr., Doulos Consulting Services BFN FLEX - BFN-SBO-CASE-0003B-01-014-RHRHX 02222013
9. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"
10. NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors", Revision 1
11. "Order to Enhance Spent Fuel Pool Instrumentation", EA-12-051
12. Sargent and Lundy Study: "Loss of HVAC During ELAP", Project 12938-012
13. Surveillance Instructions
    a. 1-SR-3.4.9.1(1) Reactor Heatup and Cooldown Rate Monitoring
14. 1,2,3-AOI-78-1, Fuel Pool Cleanup System Failure

Notes:
None

(Section 5) Identify how strategies will be deployed in all modes. **Ref: NEI 12-06, section 13.1.6**	*Describe how the strategies will be deployed in all modes.*

Deployment routes shown in Figure 3b, Attachment 3 will be utilized to transport FLEX equipment to the deployment areas. The identified paths and deployment areas will be accessible during all modes of operation (however, deployment location for some equipment will be different for flood conditions and the identified paths may be inundated after deployment, in case of a beyond-design-basis flood). This deployment strategy will be included within an administrative program in order to keep pathways clear or to clear the pathways. Debris removal guidance will be provided in the new procedure 0-FSI-6A, Beyond Design Basis External Event (BDBEE) Damage Assessment (Ref. 3) (Open Items, OI 2 and OI 14).

References:

1. Attachment 3
   a. Figure 4
2. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"
3. 0-FSI-6A, Beyond Design basis External Event (BDBEE) Damage Assessment

Notes:

None

(Section 6) Provide a milestone schedule. This schedule should include:
• **Modifications timeline**
  ○ **Phase 1 Modifications**
  ○ **Phase 2 Modifications**
  ○ **Phase 3 Modifications**
• **Procedure guidance development complete**
  ○ **Strategies**
  ○ **Maintenance**
• **Storage plan (reasonable protection)**
• **Staffing analysis completion**
• **FLEX equipment acquisition timeline**
• **Training completion for the strategies**
• **Regional Response Centers operational**
 	
Ref: NEI 12-06, section 13.1
	The dates specifically required by the order are obligated or committed dates. Other dates are planned dates subject to change. Updates will be provided in the periodic (six month) status reports.
	See attached milestone schedule Attachment 2

See attached milestone schedule in Attachment 2.

References:

1. Attachment 2
2. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"

Notes:

None

(Section 7) Identify how the programmatic controls will be met. **Ref: NEI 12-06 section 11** **JLD-ISG-2012-01 section 6.0**	*Provide a description of the programmatic controls equipment protection, storage and deployment and equipment quality. See section 11 in NEI 12-06. Storage of equipment, 11.3, will be documented in later sections of this template and need not be included in this section.* *See section 6.0 of JLD-ISG-2012-01.*

Browns Ferry Nuclear Plant will implement an administrative program for implementation and maintenance of the BFNP FLEX strategies in accordance with NEI 12-06 guidance.

- *Equipment quality:* The equipment for ELAP will be dedicated to FLEX and will have unique identification numbers. Installed structures, systems and components pursuant to 10 CFR 50.63(a) (Ref. 1) will continue to meet the augmented quality guidelines of Regulatory Guide 1.155, Station Blackout (Ref. 4).
- *Equipment protection:* BFNP will construct structures to provide protection of the FLEX equipment to meet the requirements identified in NEI 12-06 section 11 (Ref. 3a). The schedule to construct the structures is still to be determined.
- *Storage and deployment:* BFNP will develop procedures and programs to address storage structure requirements and deployment/haul path requirements relative to the hazards applicable to BFNP.
- *Maintenance and Testing:* BFNP will utilize the standard EPRI industry PM process for establishing the maintenance and testing actions for FLEX components. The administrative program will include maintenance guidance, testing procedures and frequencies established based on type of equipment and considerations made within the EPRI guidelines.
- *Design Control:* BFNP will follow the current programmatic control structure for existing processes such as design and procedure configuration.

References:

1. 10 CFR 50.63(a)
2. Draft Interim Staff Guidance JLD-ISG-2012-01, Compliance with Order EA-12-049, “Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond-Design-Basis External Events”; Docket ID NRC-2012-0068
3. NEI 12-06, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide”
    a. Section 11
4. Regulatory Guide 1.155, Station Blackout
5. NPG-SPP-09.3, Plant Modifications and Engineering Change Control

Notes:

None

(Section 8) Describe training plan	*List training plans for affected organizations or describe the plan for training development*

New training of general station staff and EP will be performed prior to the first BFNP unit design implementation outage. These programs and controls will be implemented in accordance with the Systematic Approach to Training (Open Item, OI 18).

References:

None

Notes:

None

(Section 9) Describe Regional Response Center plan	*Discussion in this section may include the following information and will be further developed as the Regional Response Center development is completed.* • *Site-specific RRC plan* • *Identification of the primary and secondary RRC sites* • *Identification of any alternate equipment sites (i.e., another nearby site with compatible equipment that can be deployed)* • *Describe how delivery to the site is acceptable* • *Describe how all requirements in NEI 12-06 are identified*

The nuclear industry will establish two Regional Response Centers (RRCs) to support utilities during beyond-design-basis events. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested; the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area, established by the Strategic Alliance for FLEX Emergency Response (SAFER) team and TVA. Communications will be established between BFNP and the SAFER team and required equipment moved to the site as needed. First arriving equipment, as established during development of BFNP's playbook, will be delivered to the site within 24 hours from the initial request.

TVA has established a contract with the SAFER team in accordance with the requirements of NEI 12-06, Section 12 (Open Item, OI 19).

References:

1. AREVA NP Inc., Engineering Information Record, Document No.: 51 - 9213690 – 001, SAFER Response Plan Master Templates

Notes:

None

Maintain Core Cooling
(Section 10) Determine Baseline coping capability with installed coping[1] modifications not including FLEX modifications, utilizing methods described in Table 3-1 of NEI 12-06: • **RCIC/HPCI/IC** • **Depressurize RPV for injection with portable injection source** • **Sustained water source**
BWR Installed Equipment Phase 1:
Provide a general description of the coping strategies using installed equipment including modifications that are proposed to maintain core cooling. Identify methods (RCIC/HPCI/IC) and strategy (ies) utilized to achieve this coping time. Power Operation, Startup, and Hot Shutdown At the initiation of the Beyond-Design-Basis External Event (BDBEE), Main Steam Isolation Valves (MSIVs) automatically close, feedwater is lost, and Safety Relief Valves (SRVs) automatically cycle to control pressure, causing reactor water level to decrease. When reactor water level reaches -45 inches from instrument zero, Reactor Core Isolation Cooling (RCIC), 1,2,3-OI-71 (Ref. 6a) and High Pressure Coolant Injection (HPCI), 1,2,3-OI-73 (Ref. 6b), automatically start with normal suction from the Condensate Storage Tanks (CST) and inject to the RPV. This HPCI/RCIC injection recovers the reactor level to the normal band. Condensate Storage Tanks (CSTs) at BFNP are not qualified for all the hazards listed in Section 1 and therefore, are not credited for Phase 1 coping, but they would be used if available. The SRVs control reactor pressure, 0-AOI-57-1A, "Loss of Offsite Power (161 and 500 KV)/Station Blackout" (Ref. 1a). If a CST is NOT lost, it will be used for injection, after the safety related battery chargers are reenergized, and the heatup curve of the suppression pool will be less severe. If CST suction is available, this ultimately results in an increase in water mass in the suppression pool. Reactor Core Isolation Cooling (RCIC) will be used for vessel level control and Main Steam Relief Valves (MSRVs) will be used for pressure control. After 20 minutes, a cooldown is initiated near the maximum allowable rate (100°F/hour), per the guidance given in GEH Evaluation of FLEX Implementation Guidelines (Ref. 5) and AOI-57-1A. After confirmation the Emergency Diesel Generators (EDGs) cannot be restarted, but no later than one hour, the crew enters the FLEX guidelines. RCIC trip and isolation signals will be overridden in accordance with FLEX procedural guidance for ELAP. EOI Appendices will be utilized. Some already exist, others will be added by EPG Rev. 3. EOI Appendix 16A, "Bypassing RCIC Low RPV Pressure Isolation" – Lifted leads in el. 621' of the Reactor bldg. EOI Appendix 16H, "Bypassing RCIC High RPV Water Level Shutdown Interlocks" – Using Emergency transfer switch at breaker compartment, by verifying valve 71-8, Steam supply valve is open and placing switch in emergency. This is

[1] Coping modifications consist of modifications installed to increase initial coping time, i.e., generators to preserve vital instruments or increase operating time on battery powered equipment.

performed at 250 RMOV Bd 1C, 2C or 3C el. 565’ of Reactor bldg. EOI Appendix 16K, “Bypassing RCIC High Temperature Isolation” - Booted contacts in Aux Instrument Room and El. 621’ of the Reactor Bldg.

The automatic depressurization system will be prevented from automatically initiating while low pressure makeup is not available (with keylock switches). The primary method of reactor pressure control is operation of the MSRVs. Operator control of reactor pressure using MSRVs requires DC control power and pneumatic pressure (supplied by station batteries and the drywell pneumatics system, respectively).

When it is determined that the safety related battery chargers are not energized, personnel will be dispatched to perform DC load shed in order to increase availability of the batteries to at least 8 hours. New procedure, O-FSI-3G “Load Shed of 250v Main Bank Battery 1, 2 & 3”, is being developed to implement the load shed.

For Phase 1, power for the MSRVs is supplied by the station batteries. At event initiation the nitrogen storage tank, with a backup supply from the Containment Atmosphere Dilution system, automatically supplies pneumatic pressure for MSRV operation. However, these nitrogen tanks are not designed to withstand all BDBEE and a modification will be performed to provide a backup nitrogen control station within the Reactor Buildings for BFNP-1, 2 and 3. In addition, each Automatic Depressurization System (ADS) MSRV is provided an accumulator which contains enough pneumatic pressure to operate each valve through five open/close cycles, per the Updated Final Safety Analysis Report (UFSAR) (Ref. 3a). Mechanical SRV operation will also control reactor pressure at the safety relief setpoint.

RCIC exhaust and MSRV cycling will increase torus and drywell temperatures and pressures. Plant stability can be maintained during Phase 1 of the beyond-design-basis event by following the guidance in GEH Evaluation of FLEX Implementation Guidelines (Ref. 5).

1. Containment design limits will not be exceeded for temperatures or pressures (Ref. 5).
2. Suppression pool temperature increases will not result in RCIC failure from lube oil heating or from loss of Net Positive Suction Head (NPSH) (considering the projected torus pressure) Browns Ferry Post Fukushima FLEX Response Evaluation (Ref. 2) and GEH Evaluation of FLEX Implementation Guidelines (Ref. 5). Browns Ferry Nuclear Plant will take actions as necessary to assure RCIC can operate at elevated temperatures (Open Item, OI 7).
3. Battery supplies will be sufficient for RCIC, Main Steam Relief Valves (MSRVs), Hardened Containment Vent System (HCVS) and for indication, considering load shed manual actions, Browns Ferry Post Fukushima FLEX Response Evaluation (Ref. 2).
4. MSRV solenoid voltage will be sufficient for higher drywell temperatures up to 340 degrees F.
5. MSRV operating gas will be sufficient for higher drywell pressures.

In accordance with Emergency Procedure Guidelines (EPGs) and per Boiling Water Reactors Owner’s Group (BWROG) guidance, Emergency Operating Procedures (EOPs) have been revised to allow termination of RPV emergency depressurization at a controlled pressure reduction rate to a pressure that will allow continued RCIC operation, because steam driven RCIC is the sole means of core cooling (approximately 150-250 psig).

The Operators will use CST suction initially if it is available, and while this improves NPSH for RCIC and decreases the containment temperature trends, it can challenge Heat Capacity

Temperature Limit (HCTL) (for Torus/Suppression Pool), Pressure Suppression Pressure (PSP) (a function of Primary Containment Water Level) or MSRV tailpipe limits because of the increasing water level in the torus. Without venting, the drywell design temperature limit of 281°F will be reached in approximately 9 hours if suction is from the suppression pool. GEH Evaluation of FLEX Implementation Guidelines (Ref. 5) indicates the temperature limit will be reached at approximately 11 hours if suction is from the CST. Emergency Operating Instructions (EOIs)/Flex Support Guidelines (FSGs) will be revised to direct Operators to terminate RPV emergency depressurization to prevent loss of RCIC.

By the end of 8 hours, the RCIC makeup rate required is approximately 240 gpm. If the CST is being used (and it is not credited), suction will be transferred either when suppression pool water level approaches the EOI limit (19 feet) or when the suppression pool temperature rises to a value that could threaten RCIC operation (~240 degrees by analysis contained in Project Task Report, BWROG RCIC Pump and Turbine Durability Evaluation – Pinch Point Study, 0000-0155-1545-R0 (Ref. 12)). Once suction is transferred to the suppression pool (which may be at the beginning of the event if the CST is lost due to the beyond-design-basis initiating event) essentially all of the mass added via RCIC injection into the reactor vessel is returned to the suppression pool by the MSRVs.

Cold Shutdown and Refueling

The overall strategy for core cooling for Cold Shutdown and Refueling are, in general, similar to those for Power Operation, Startup, and Hot Shutdown.

If an ELAP occurs during Cold Shutdown, water in the vessel will heatup. When temperature reaches 212°F, (Hot Shutdown) the vessel will begin to pressurize. During the pressure rise RCIC can be returned to service with suction from the CST to provide injection flow. When pressure rises to the SRV setpoints then pressure will be controlled by SRVs. The primary and alternate strategies for Cold Shutdown are the same as those for Power Operation, Startup, and Hot Shutdown as discussed above for core cooling. The drywell airlock may be open, but the amount of steaming will have limited impact on the Reactor Building until Phase 2 manpower is available to shut the airlock before Phase 2 actions are required in the Reactor Building airlock area.

During Refueling, there are many variables that impact the ability to cool the core. In the event of an ELAP during Refueling, there are no installed plant systems available to cool the core; thus, transition to Phase 2 will occur immediately. Phase 2 is discussed in Section 11.

BFN will follow the guidance contained within the Nuclear Energy Institute (NEI) position paper dated September 18, 2013, entitled "Position Paper: Shutdown/ Refueling Modes" (Agencywide Documents Access and Management Systems (ADAMS) Accession No. ML13273A514) which the NRC has endorsed.

Details:	
(Section 10a) Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation*

Browns Ferry Nuclear Plant will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06 (Ref. 6). These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs (Open Item, OI 17).

Maintain Core Cooling

(Section 10b) Identify modifications	*List modifications*

- Change power supply of containment instrumentation (drywell atmospheric temperature and suppression pool level) from the AC instrument bus to station battery to provide continuous power to critical instruments so that critical containment parameters can be monitored throughout the event. (Open Item, OI 9)
- Change power supply of RPV level instrument (shutdown floodup range) to provide continuous power to allow an expanded level range to be monitored.
- Install a protected nitrogen control station to provide backup pneumatic supply to the MSRVs. (Open Item, OI 4)
- Perform modifications, as necessary, to ensure that the RCIC inventory control function is seismically robust. (Open Item, OI 8)
- Label non-critical DC loads to allow Operators to more readily identify the loads that will be shed during the Phase 1 load shedding activity. (Open Item, OI 9)

(Section 10c) Key Reactor Parameters	*List instrumentation credited for this coping evaluation.*

1,2,3-LI-3-52 Reactor Vessel Water Level – Post Accident Flood Range (Div I)

1,2,3-LI-3-62 RPV Level Reactor Vessel Water Level – Post Accident Flood Range (Div II)

1,2,3-LI-3-58A Reactor Vessel Water Level – Emergency Systems Range (Div I)

1,2,3-LI-3-58B Reactor Vessel Water Level – Emergency Systems Range (Div II)

1,2,3-PI-3-74A Reactor Pressure (Div I)
1,2,3-PI-3-74B Reactor Pressure (Div II)

1,2,3-LI-3-55 Shutdown Floodup Range

The instrumentation listed above is or will be supplied power via the Class 1 Safety Related Batteries and are located in the Main Control Room. A reference source for the plant operators will be developed that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy (NE 12-06, Section 3.2.1.10). This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings as close to containment penetrations, as possible, where available. Portable instrument (e.g., a Fluke meter) can be used, as applicable. Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance will include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power (Open Item, OI 5). Browns Ferry's evaluation of the FLEX strategy may identify additional parameters that are needed in order to support key actions identified in the plant procedures/guidance or to indicate imminent or actual core damage (NEI 12-06 Rev. 0 Section 3.2.1.10) and any differences will be provided in a future 6-month update following identification.

Maintain Core Cooling

References:

1. Abnormal Operating Instructions (AOIs)
   a. 0-AOI-57-1A, Loss of Offsite Power (161 and 500 KV)/Station Blackout
2. AREVA Engineering Information Record Document No.: 51-9198045-000, "Browns Ferry Post Fukushima FLEX Response Evaluation"
3. Browns Ferry Nuclear Plant (BFNP) Updated Final Safety Analysis Report (UFSAR)
   a. Section 4.4-4
4. EOI Program Manuals (i.e., NPSH Limit Worksheets)
5. "GEH Evaluation of FLEX Implementation Guidelines", NEDC-33771P, Revision 0
6. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"
7. Plant Operating Instructions
   a. 1-OI-71, RCIC System
   b. 1-OI-73, HPCI System
8. "Position Paper: Shutdown/ Refueling Modes" (Agencywide Documents Access and Management Systems (ADAMS) Accession No. ML13273A514)
9. 1,2,3-AOI-57-11, Loss of Power to An ECCS ATU Panel / ECCS Inverter
10. Unit 1,2,3 Technical Requirements Manual Bases 3.3.3.1, Post Accident Monitoring (PAM) Instrumentation
11. O-FSI-3G "Load Shed of Class 1E 250v DC Battery"
12. Project Task Report, BWROG RCIC Pump and Turbine Durability Evaluation – Pinch Point Study, 0000-0155-1545-R0

Notes:

The duration of each station battery was calculated to last no less than 12 hours following a load shed at 4 hours.

Maintain Core Cooling
(Section 11) BWR Portable Equipment Phase 2:

Provide a general description of the coping strategies using on-site portable equipment including modifications that are proposed to maintain core cooling. Identify methods (RCIC/HPCI/IC) and strategy (ies) utilized to achieve this coping time.

During Phase 1, plant personnel deploy FLEX equipment. For flood events, the equipment is staged many hours before the peak flood waters exceed the design basis (see Attachment 1A). For other events, equipment deployment is initiated beginning with the SBO condition – in some cases, before an ELAP is declared (see timeline, Attachment 1A).

The following is a list of major equipment that is planned to be onsite, protected (within the limitations described) and ready for use at or before the beginning of Phase 2.

1) Two redundant 850kw, 480v FLEX Generators will be permanently staged in the FESB to meet N+1 requirements. They are protected for all of the extreme natural events in Section 1. A single DG has sufficient capacity to supply all safety related 250v battery chargers via a load control center that will be used for distribution.. These will be available during Phase 2; by connection directly to the input supply breaker to the chargers (Refer to Attachment 3, Figure 1)
2) Two 1.1MWe, 4kv FLEX Support Generators will be permanently staged in the FESB. It is currently estimated that these generators can be deployed within 12 hours. They would be used to energized the safety related 4kv distribution system and energize loads such as 120v ac instrumentation, ventilation, pump motors and motor operated valves.
3) Each FLEX Pumping System (FPS1, FPS2, FPS3, FPS+1) consists of a portable FLEX Low Pressure Pump (FLPP) driven by a 600 HP diesel pump rated at 5000 gpm at 150 psi discharge head and a FLEX Floating Booster Pump (FLBP). The FLBP is an integrated, transportable pumping module capable of providing up to 5,000 gpm of water at 90 ft. total dynamic head. The system utilizes two floating submersible pumps, designated "satellite pumps," to supply water from an open source to a remote high-capacity pumping system, located as high as 50 ft. above and 150 ft. away in distance. A 300 hp diesel engine powers the hydraulic system. Two engine mounted variable displacement pumps provide pressurized hydraulic fluid to the satellite pump motors through 150 ft. hose lines. The hose lines are retrieved and stored on two hose reels driven independently by electric motors. An electronic engine management system controls and monitors the engine and provides the operator with real time supervision of all critical engine parameters and hydraulic conditions (Refer to Attachment 3, Figure 5). TVA is designing deployment locations for the pumps, including ramps, winches or other transfer assemblies as necessary to deploy all pumps and hoses within the Phase 1 coping interval. The staff begins deployment of these pumps as soon as SBO occurs rather than waiting to exhaust all attempts to restore the emergency electric supply system. It is currently estimated that FPS1, FPS2 and FPS3 will be deployed and connected to provide backup RPV, SFP and Containment level addition at approximately 6, 7, and 8 hours respectively into the event. The staff begins deployment of

Maintain Core Cooling
(Section 11) BWR Portable Equipment Phase 2:

these pumps as soon as SBO occurs rather than waiting to exhaust all attempts to restore the emergency electric supply system.

a) FLEX Pumping Systems are assigned as follows.
   i) FPS1 can be connected to one or more of the following:
      (1) Three Containment Integrated Leak Rate Test (CILRT) penetrations through Reactor Building wall, elevation 565' (4" pipe) - inside 1A, 2A, 3A RHRSW pipe tunnel, (From inside the Reactor Building, connections can be made to the Condensate Storage & Supply System and then to the vessel through RHR Loop I & II LPCI injection lines and Core Spray Loop I & II injection lines, to SFP makeup (normal), or to the Containment and Torus via their respective RHR Loop I and II flowpaths),
      (2) The EECW South header - At the intake structure (The EDGs will be isolated by manual action if needed to ensure adequate cooling to operating SSCs). The south header can be used for SFP makeup and for all normally supplied loads with the exception of the control air compressors.
   ii) FPS2 will be aligned to B RHRSW at the following location;
      (1) At the intake structure,
      Note: The B RHRSW can provide standby coolant to Unit 2 and/or Unit 3, if needed.
   iii) FPS3 will be aligned at the following location:
      (1) At the intake structure,
      Note : The D RHRSW can provide standby coolant to Unit 1 and/or Unit 2, if needed.
   iv) (FPS4) - (N+1), is a spare.

4) Augmented operating gas will be staged for the Main Steam Relief Valves (MSRVs).

Primary Phase 2 strategy for a unit that is not in cold shutdown.

During Phase 2, as in Phase 1, reactor core cooling is initially maintained using RCIC in automatic or manual mode (i.e., with Operators controlling the RCIC flow controller) with suction from the suppression pool or the CST (if available). The CST is not credited as being able to sustain all events in Section 1; however, it would be used if available, because it provides additional margin before containment temperature is challenged, and it reduces the temperature of the RCIC bearing cooler. This plan addresses CST use because if the CST survives, its use requires consideration of the need for mass removal from the CST.

Reactor Core Isolation Cooling (RCIC) will ultimately be secured with vessel makeup taken over by FPS2 and/or FPS3. Suppression pool water level will increase if there is addition from the CST (if it is not offset by anticipatory venting of the wetwell). Addition of water from the CST will be terminated if necessary to prevent challenging the containment control limits and to maintain availability of the Hardened Containment Vent System (HCVS). The battery

Maintain Core Cooling
(Section 11) BWR Portable Equipment Phase 2:

chargers will be available from either the 480 V FLEX DGs or Spare 480v FLEX DG..

Suppression pool water level can be reduced by operation of HPCI (after battery chargers are available) in modified CST test mode (suction from torus, discharge to the CST, if available). Containment pressure could also potentially be used as a driving force to reject water from the torus back to the CST without pumping power (RHR drain pump system); however, this alternative is still under consideration. These strategies are still evaluation.

FPS2 and FPS 3 will use the Tennessee River as their source of suction supply. The pumps will be deployed in the vicinity of the Intake Pumping Station, depending on whether the event is a flood or non-flood event will determine the exact deployment location (Attachment 3, Figure 2A & 2B). Debris entering into the suction of FPS2 and FPS 3 will be mitigated by strainers located in the suction supply flowpath. The BWROG has issued BWROG-TP-14-006, Rev. 0 March 2014, "Fukushima Response committee Raw Water Issue: Fuel inlet blockage from debris", to address fuel blockage from debris present in raw water injection. If the fuel inlet becomes blocked, assuring that injected water reaches the inside core shroud region and thus enter the fuel through the top of the channel is the primary strategy. Utilization of this strategy requires approval and implementation of an expanded water level band (the upper band which would be just below the main steam lines) in the Emergency Operating Instructions that is being tracked by the BWROG Emergency Procedures Committee under issue 1216.

During Phase 2, reactor pressure is controlled by manual operation of MSRVs as described in Phase 1. As backup to the nitrogen tank and the MSRV accumulators, a pre-staged emergency N2 control station will be utilized, as necessary. This N2 control station will be added by plant modification.

Alternate Phase 2 strategy for a unit that is not in cold shutdown.

RCIC will continue to supply makeup to the reactor vessel as in Phase 1.

The discussion in this paragraph is applicable to Unit 2 only. During Phase 2, the HCVS will be opened for anticipatory venting; otherwise the drywell temperature limit would be reached per GEH Evaluation of FLEX Implementation Guidelines (Ref. 5). Hardened Containment Vent System (HCVS) operation will be controlled to ensure overpressure for RCIC NPSH. The mass loss through the HCVS (225 gpm estimated in Ref. 5) will eventually have to be made up. If Phase 3 is not available yet, the torus level will be restored as needed using FLEX Pumping System, FPS2 or FPS3 (water from the Tennessee River). Suppression pool and containment temperatures/pressures will eventually be reduced and RCIC operation can continue for vessel injection as long as the steam supply is adequate.

If Phase 3 has not been entered when RCIC goes offline, FLEX Pumping System, FPS2 and FPS3 can be used to provide vessel makeup after pressure is lowered (normally; however, if the

Maintain Core Cooling
(Section 11) BWR Portable Equipment Phase 2:

decay heat is no longer sufficient to maintain a continuous RCIC steam supply, RCIC would be operated intermittently until a low pressure makeup from the cleanest water source available could be placed in service either in Phase 2 or 3). Alternatively, FLEX Pumping Systems (FPS2 or FPS3) can provide river water injection to the vessel via the standby coolant crosstie from RHRSW. Vessel makeup (T+6 hours and later) requirements will be less than 250 gpm (Ref. 5); therefore, use of FPS2 or FPS3 supplies will not significantly impact the other units that will be using this strategy.

Primary strategy for a unit that is less than RCIC supply pressure at the time of the external event:

If the plant operates in Mode 3 when the SBO occurs, there is more time available to align and start the FLEX Pumping Systems than is the case for Mode 4 operation, Technical Justification to Support Risk Informed Modification to Selected Required Action End States for BWR Plants (Ref. 4). The reason more time is available in Mode 3, which increases the probability of success, is availability of RCIC. The strategy is to transition from Mode 4 to Mode 3 with minimal inventory loss. When RCIC is started, the makeup rate is greater than the mass loss from the core. With no inventory loss other than normal system leakage (TS limit), there is sufficient water to prevent uncovering the core before the FLEX Pumping Systems can be utilized in Phase 2.

Primary strategy for a unit that is in Cold Shutdown and Refueling:

During Refueling, many variables exist which impact the ability to cool the core. In the event of an ELAP during Refueling, there are no installed plant systems available to cool the core; thus, transition to Phase 2 will occur immediately. To accommodate the activities of vessel disassembly and refueling, water levels in the reactor vessel and the reactor cavity are often changed. The most limiting condition is the case in which the reactor head is removed and water level in the vessel is at or below the reactor vessel flange. If an ELAP/LUHS (Extended Loss of AC Power /Loss of Ultimate Heat Sink) occurs during this condition then boiling in the core may occur quite rapidly (dependent on the time after shutdown).

Pre-staging of FLEX pumps, except in case of events with adequate warning times, cannot be credited per the guideline of NEI 12-06 (Ref. 6) since an event could disable any pre-staged pump. Deploying and implementation of FLEX equipment to supply injection flow must commence immediately from the time of the event and must be rapid enough to prevent fuel uncovery. Note that the rate of heat addition in cold shutdown is low and the required vessel makeup rate is very low; therefore, there should be sufficient time to establish vessel injection. During an outage period, there are more personnel on site to provide the necessary resources. Guidance will be provided to ensure that sufficient area is available for deployment and that haul paths remain accessible without interference from outage equipment during refueling outages. Outage risk management procedures will be updated to include FLEX equipment as part of outage risk management.

Maintain Core Cooling
(Section 11) BWR Portable Equipment Phase 2:
BFN will follow the guidance contained within the Nuclear Energy Institute (NEI) position paper dated September 18, 2013, entitled "Position Paper: Shutdown/ Refueling Modes" (Agencywide Documents Access and Management Systems (ADAMS) Accession No. ML13273A514) which the NRC has endorsed.
Details:

(Section 11a) Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation*

Browns Ferry Nuclear Plant will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06 (Ref. 6). These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs (Open Item, OI 17).

Maintain Core Cooling
(Section 11) BWR Portable Equipment Phase 2:

(Section 11b) Identify modifications	*List modifications all connections will be accessible*

- Construct a Flexible Equipment Storage Building (FESB), located above the Probable Maximum Flood (PMF) level, which is adequately protected from the hazards listed in Section 1. The storage facility(s) will be used to store support equipment and items, including the four FLEX Pumping Systems, one Spare FLEX DG, equipment deployment vehicles and debris/snow clearing equipment. (Open Items, OI 9 and OI 10)
- Provide adequate staging area above the PMF for the 480v generators and connection points to provide power to the class 1E safety related battery chargers. Provide a load distribution center to supply other auxiliary power requirements.
- Install connection points on the "B" and "D" RHRSW piping at the Intake for the FLEX pump discharge hose connections. **"B" header provides Unit 2 & Unit 3 compliance. "D" header provides Unit 1 & Unit 2 compliance.**

• Install connection point(s) on the common South EECW header piping at the Intake Structure for the FLEX pump discharge hose connections (common system for all 3 units). • Modify currently installed hardened wetwell vent to install backup pneumatic supply or provided procedural guidance for manual operation, to allow use within current design limits. (Open Items, OI 9 and OI 11) • Modify RCIC lube oil cooling line to allow a hose to be connected from the South EECW header nearby to provide turbine lube oil cooling for RCIC. This strategy utilizes FPS1 to provide the cooling water supply.	
(Section 11c) Key Reactor Parameters	*List instrumentation credited or recovered for this coping evaluation.*
Same as instruments listed in above section, Maintain Core Cooling Phase 1	
(Section 11d) Storage *I* Protection of Equipment : Describe storage / protection plan or schedule to determine storage requirements	
Seismic	*List how equipment is protected or scheduled to protect*
Portable equipment and connection materials required to implement this FLEX strategy will be maintained in the FESB or another structure, which is designed to meet or exceed BFNP design basis Safe Shutdown Earthquake (SSE) protection requirements.	
Flooding Note: if stored below current flood level, then ensure procedures exist to move equipment prior to exceeding flood level	*List how equipment is protected or scheduled to protect*
Portable equipment required to implement this FLEX strategy will be maintained in the FESB, which is sited in a suitable location that is above the PMF level and as such is not susceptible to flooding from any source. FLEX equipment deployment paths maintain a minimum elevation of 565' for which the plant will have over 5 days to deploy FLEX equipment based on plant response to a flooding event in 0-AOI-100-3 (Ref. 1b). See Updated Final Safety Analysis Report (UFSAR) Section 2.4A, Figure 16 (Ref. 3a)	
Severe Storms with High Winds	*List how equipment is protected or scheduled to protect*
Portable equipment required to implement this FLEX strategy will be maintained in the FESB which is designed to meet or exceed the licensing basis high wind hazard for BFNP.	
Snow, Ice, and Extreme Cold	*List how equipment is protected or scheduled to protect*
The FESB will be evaluated for snow, ice, and extreme cold temperature effects. Heating will be provided as required to assure no adverse effects on the FLEX equipment. The FESB will	

have a stand-alone HVAC system.

High Temperatures	*List how equipment is protected or scheduled to protect*
The FESB will be evaluated for high temperature effects and ventilation will be provided as required to assure no adverse effects on the FLEX equipment. The FESB will have a stand-alone HVAC system.	

(Section 11e) Deployment Conceptual Modification
(Attachment 3 contains Conceptual Sketches)

Strategy	**Modifications**	**Protection of connections**
Identify strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*
• Three FLEX Pumping Systems will be deployed to supply river water into existing systems**.**		
• FLEX Pumping System (FPS1) will be deployed to supply water into the South EECW header via installed connections at the intake pumping station**.**	• Install hose connections sized for FPS1 on the EECW header that will be connected to the South EECW header at the intake pumping station.	
• FLEX Pumping System (FPS2) will be deployed to supply water into the RHRSW “B” header via installed connections at the intake pumping station.	• Install hose connections sized for FPS2 on the RHRSW “B” header at the intake pumping station. **“B” header provides Unit 2 & Unit 3 compliance. “D” header provides Unit 1 & Unit 2 compliance.**	The connections are being installed on piping that are in a seismically designed structure and are not impacted by outside hazards.
• FLEX Pumping System (FPS3) will be deployed to supply water into the RHRSW “D” header via installed connections at the intake pumping	• Install hose connections sized for FPS3 on the RHRSW “D” header at the intake pumping station.	Connection points will be made within the Seismic Class 1 Control Bay.

station. • 480v FLEX DG for battery charging and other loads	• Modify staging area to facilitate PMF, provide connections to the class 1E safety related battery chargers and provide a load distribution center.	Emergency Diesel generator 7-day tanks are located underneath the safety related Diesel Generators and protected from all the conditions listed in NEI 12-06, Section 1. The deployment trucks and portable fuel transfer pumps will be stored in the FESB which is protected from all the conditions listed in NEI 12-06, Section 1.
• Portable fuel transfer pumps will remove fuel from the Emergency Diesel Generator 7 day tanks to fill equipment fuel tanks. Deployment trucks will also be equipped with a fuel storage tank to transfer fuel to locations in need of fuel.	• Modifications may be performed to facilitate access to the Emergency Diesel Generator 7 day tanks and facilitate portable fuel transport pump connection.	
• Expand the upper band of RPV level that should be maintained when raw water is injected to the RPV.	• Provide DC power supply to 1,2,3-LI-3-55, Shutdown Floodup Range, in order to monitor an expanded water level band up to the bottom of the Main Steam Lines (to ensure adequate core cooling with inlet core debris clogging)	Instrument and power supply are located in seismic class 1 structure

References:

1. Abnormal Operating Instructions (AOIs)
   a. 0-AOI-57-1A, section 4.2
   b. 0-AOI-100-3, Flood Above Elevation 558'
2. Attachment 1A Timeline, Attachment 1A

3. Browns Ferry Nuclear Plant (BFNP) Updated Final Safety Analysis Report (UFSAR)
   a. Section 2.4A
4. BWROG Report, NEDC-32988-A, Rev 2, "Technical Justification to Support Risk Informed Modification to Selected Required Action End States for BWR Plants," Section I (NRC's SE) and Section II (Responses to NRC's RAI), ML030170060
5. “GEH Evaluation of FLEX Implementation Guidelines”, NEDC-33771P, Revision 0
6. NEI 12-06, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide”
   a. Section 7.3.1.1.b
7. BWROG-TP-14-006, Revision 0 March 2014, “Fukushima Response Committee Raw Water Issue: Fuel inlet blockage from debris”
8. BWROG Emergency Procedure Committee, Issue 1216

Notes:

None

Maintain Core Cooling

(Section 12) BWR Portable Equipment Phase 3:

Provide a general description of the coping strategies using Phase 3 equipment including modifications that are proposed to maintain core cooling. Identify methods (RCIC/HPCI/IC) and strategy(ies) utilized to achieve this coping time.

Primary (and Alternate) Strategy

For Phase 3, the core cooling maintenance strategy is initially dependent on the strategy being implemented in Phase 2 (primary or alternate); however, the end state strategy is the same.

1. Phase 3 will provide additional support to continue and reinforce the Phase 2 strategy. Phase 3 will provide (6) ~ 1 MWe Generators & load distribution centers, high capacity low pressure pumps with booster pump assemblies to backup FPS1, FPS2, & FPS3, additional diesel fuel, supplies and redundancy for the FLEX equipment being used. Additionally, Phase 3 equipment capable of providing for demineralized water to makeup to the torus, Spent Fuel Pool (SFP), and Reactor Pressure Vessel (RPV) as necessary.

Details:

(Section 12a) Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation*

Maintain Core Cooling
(Section 12) BWR Portable Equipment Phase 3:
Browns Ferry Nuclear Plant will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06 (Ref. 1). These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs (Open Item, OI 17).

Maintain Core Cooling	
(Section 12b) Identify modifications	*List modifications*
• The RRC pumps, if needed (to replace the FLEX Pumping Systems in service), will utilize the same piping connections developed for Phase 2. • Modifications will allow for the connection of RRC DGs to replace any FLEX DG that has failed.	
(Section 12c) Key Reactor Parameters	*List instrumentation credited or recovered for this coping evaluation.*
Same as instruments listed in Section10c, augmented by the instruments associated with monitoring the DGs and Pumping Systems provided by the RRC.	

(Section 12d) Deployment Conceptual Modification **(Attachment 3 contains Conceptual Sketches)**		
Strategy	**Modifications**	**Protection of connections**
Identify strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*
Phase 3 equipment will be provided by the RRC, which is to be located in Memphis, TN. Equipment transported to the site will be either immediately staged at the	No modifications identified for Phase 3 deployment issues	• The FLEX/RRC pump make-up connections are the same as described for Phase 2 and shall be protected against the specific hazards used in the strategy (i.e., some high point connections may be isolated and not used for

point of use location (pumps and generators) or temporarily stored at the lay down area shown on Figure 4 until moved to the point of use area. Deployment paths identified on Figure 4 will be used to move equipment as necessary.		tornadoes, but implemented for floods). • The 480 VAC FLEX connection panels are located in a structure and at an elevaation protected for all hazards. The RRC 480 VAC DGs can be connected even if the 480 V FLEX Generators were lost in a tornado event. • All other equipment will be portable.
Expand the upper band of RPV level that should be maintained when raw water is injected to the RPV.	Provide DC power supply to 1,2,3-LI-3-55, Shutdown Floodup Range, in order to monitor an expanded water level band up to the bottom of the Main Steam Lines (to ensure adequate core cooling with inlet core debris clogging)	Instrument and power supply are located in seismic class 1 structure

Maintain Core Cooling

References:

1. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"

Notes:

None

Maintain Containment
(Section 13) Determine Baseline coping capability with installed coping[2] modifications not including FLEX modifications, utilizing methods described in Table 3-1 of NEI 12-06: • **Containment Venting or Alternate Heat Removal** • **Hydrogen Igniters (Mark III containments only)**
BWR Installed Equipment Phase 1:
Provide a general description of the coping strategies using installed equipment including modifications that are proposed to maintain containment integrity. Identify methods (containment vent or alternative / Hydrogen Igniters) and strategy (ies) utilized to achieve this coping time. During Phase 1, the primary strategy is to control reactor parameters so as not to challenge containment limits within the first 6 hours of the event to give time to deploy cooling pumps for Phase 2. Reactor pressure is lowered at near the maximum cooldown rate to ensure that if there were an unplanned rapid depressurization during this interval, the heat rejected from the reactor system to the containment would not exceed the ability of the Hardened Containment Vent System (HCVS) to mitigate the event on a single unit. The current as-designed HCVS is capable preventing the pressure in the pressure suppression chamber (torus) from exceeding the primary containment pressure limit of 56 psig, for a single unit, by releasing 1% of thermal power for the BFN units which have been upgraded to 3458 MWt. This vent will later be modified in accordance with the schedule for NRC Order EA-13-109 "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents Capable of Operation Under Severe Accident Conditions". Concurrent with the issuance of NRC Order EA-12-049, the NRC issued Order EA-12-050 "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents" and the NRC rescinded this order with issuance of NRC Order EA-13-109. The revised schedule and implementation timeline contained in NRC Order EA-13-109 impacts the ability to achieve full implementation of the mitigations strategy requirements of NRC Order EA-12-049 with respect to the current required dates for BFN Units 2 and 3. Relaxation and request for extension of the requirements contained in NRC Order EA-12-049 will be forthcoming in a separate correspondence. It is intended that BFN Unit 1 will comply with the timeline required by NRC Order EA-12-049 and EA-13-109. In the interim, BFN will utilize the hardened vent as currently installed and in accordance with existing procedures. (Ref. 2). (Open Item, OI 11) Anticipatory venting utilizing the hardened wetwell vent will be performed during the first 6 hours of the event based on following the operational strategies in GEH Evaluation of FLEX Implementation Guidelines (Ref. 1) and preliminary MAAP analysis performed for a single unit. Procedures would caution that venting during this timeframe, if required, must be minimized to avoid an adverse impact on Reactor Core Isolation Cooling (RCIC) Net Positive

[2] Coping modifications consist of modifications installed to increase initial coping time, i.e., generators to preserve vital instruments or increase operating time on battery powered equipment.

Suction Head (NPSH) (if RCIC must be aligned to the suppression pool rather than the Condensate Storage Tank (CST)). RCIC is the only credited vessel makeup during Phase 1. Emergency Operating Instructions contain sufficient guidance to ensure this condition is monitored and controlled.

Containment parameters will be monitored during Phase 1, initially powered by batteries, until additional air cooled diesel backed power systems are started and aligned to power the battery chargers.

Maintain Containment	
Details:	
(Section 13a) Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation*
Browns Ferry Nuclear Plant will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06 (Ref. 3). These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs (Open Item, OI 17).	
(Section 13b) Identify modifications	*List modifications*
Hardened Containment Vent System (HCVS) (i.e., Reliable Hardened Vent) is currently installed but will be enhanced in accordance with the schedule for NRC Order EA-13-109. The current hardened vent is sized to protect a single unit and will be utilized in the interim as currently installed. (Ref. 2) (Open Item, OI 11). 1,2,3-LI-64-159A & 1,2,3-64-159B, Torus Level Div. I & 2, will be modified to be DC backed up instruments. 1,2,3-TI-64-52AB, Drywell Temperature, will be modified to be DC backed up instruments.	

(Section 13c) Key Containment Parameters	*List instrumentation credited for this coping evaluation.*
Containment Essential Instrumentation	**Safety Function**
• 1,2,3-PI-64-67B, Drywell Pressure • 1,2,3-TI-64-52AB, Drywell Temperature • 1,2,3-LI-1,2,3-LI-64-159A, Wide Range Torus Level or • 1,2,3-LI-1,2,3-LI-64-159B, Wide Range Torus Level • 1,2,3-TI-64-161, Suppression Pool Temperature or • 1,2,3-TI-64-162, Suppression Pool Temperature The instrumentation listed above is supplied power via the Class 1 Safety Related Batteries and are located in the Main Control Room. A reference source for the plant operators will be developed that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy (NE 12-06, Section 3.2.1.1 0). This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings at containment penetrations, where applicable, using a portable instrument (e.g., a Fluke meter). Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance will include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power (Open Item, OI 5). Browns Ferry's evaluation of the FLEX strategy may identify additional parameters that are needed in order to support key actions identified in the plant procedures/guidance or to indicate imminent or actual core damage (NEI 12-06 Rev. 0 Section 3.2.1.10) and any differences will be provided in a future 6-month update following identification.	Containment integrity
<u>References</u>: 1. "GEH Evaluation of FLEX Implementation Guidelines", NEDC-33771P, Revision 0 2. "BWR Mark I & II Reliable Hardened Containment Vents capable of Operation Under Severe Accident Conditions", EA-13-109 3. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"	

4. Unit 1,2,3 Technical Requirements Manual Bases 3.3.3.1, Post Accident Monitoring (PAM) Instrumentation
5. 1,2,3-AOI-57-5A, Loss of I&C Bus A, to the reference section of Section 13
6. 1,2,3-AOI-57-5B, Loss of I&C Bus B, to the reference section of Section 13
7. 1,2,3-AOI-57-11, Loss of Power to An ECCS ATU Panel / ECCS Inverter

Notes:

None

Maintain Containment

(Section 14) BWR Portable Equipment Phase 2:

Provide a general description of the coping strategies using on-site portable equipment including modifications that are proposed to maintain containment integrity. Identify methods (containment vent or alternative / Hydrogen Igniters) and strategy (ies) utilized to achieve this coping time.

During Phase 1, plant personnel will started deployment of FLEX equipment. For flood events, the equipment is staged many hours before the peak flood waters exceed the design basis (see Attachment 1A). For other events, equipment is placed in service beginning with the Station Blackout (SBO) condition – in some cases, before an Extended Loss of AC Power (ELAP) is declared (see timeline, Attachment 1A).

Portable equipment and containment vent strategies are as follows:

1) Two redundant 850kw, 480v FLEX Generators will be permanently staged in the FESB to meet N+1 requirements. They are protected for all of the extreme natural events in Section 1. These will be available during Phase 2; by connection directly to the input supply breaker to the chargers. It is currently estimated that the primary 480 FLEX Generator will be deployed and connected within 6 hours. A single generator has sufficient capacity to supply three safety related 250v battery chargers via a load control center that will be used for distribution. At this point, the Class 1 250v DC safety related battery chargers are now recovered. (Refer to Attachment 3, Figure 1)
2) Two 1.1MWe, 4kv FLEX Support Generators will be permanently staged in the FESB. It is currently estimated that these generators can be deployed within 12 hours. They would be used to energized the safety related 4kv distribution system and energize loads such as 120v ac instrumentation, ventilation, pump motors and motor operated valves.
3) Each FLEX Pumping System (FPS1, FPS2, FPS3, FPS+1) consists of a portable FLEX Low Pressure Pump (FLPP) driven by a 600 HP diesel pump rated at 5000 gpm at 150 psi discharge head and a FLEX Floating Booster Pump (FLBP). The FLBP is an integrated, transportable pumping module capable of providing up to 5,000 gpm of water at 90 ft. total dynamic head. The system utilizes two floating submersible pumps, designated “satellite pumps,” to supply water from an open source to a remote high-capacity pumping system, located as high as 50 ft. above and 150 ft. away in distance. A 300 hp diesel engine powers

Maintain Containment
(Section 14) BWR Portable Equipment Phase 2:

the hydraulic system. Two engine mounted variable displacement pumps provide pressurized hydraulic fluid to the satellite pump motors through 150 ft. hose lines. The hose lines are retrieved and stored on two hose reels driven independently by electric motors. An electronic engine management system controls and monitors the engine and provides the operator with real time supervision of all critical engine parameters and hydraulic conditions (Refer to Attachment 3, Figure 5). TVA is designing deployment locations for the pumps, including ramps, winches or other transfer assemblies as necessary to deploy all pumps and hoses within the Phase 1 coping interval. The staff begins deployment of these pumps as soon as SBO occurs rather than waiting to exhaust all attempts to restore the emergency electric supply system. It is currently estimated that FPS1, FPS2 and FPS3 will be deployed and connected to provide backup RPV, SFP and Containment level addition at approximately 6, 7, and 8 hours respectively into the event. The staff begins deployment of these pumps as soon as SBO occurs rather than waiting to exhaust all attempts to restore the emergency electric supply system.

a) FLEX Pumping Systems are assigned as follows.
   i) FPS1 can be connected to one or more of the following:
      (1) Three Containment Integrated Leak Rate Test (CILRT) penetrations through Reactor Building wall, elevation 565' (4" pipe) - inside 1A, 2A, 3A RHRSW pipe tunnel, (From inside the Reactor Building, connections can be made to the Condensate Storage & Supply System and then to the vessel through RHR Loop I & II LPCI injection lines and Core Spray Loop I & II injection lines, to SFP makeup (normal), or to the Containment and Torus via their respective RHR Loop I and II flowpaths),
      (2) The EECW South header - At the intake structure (The EDGs will be isolated by manual action if needed to ensure adequate cooling to operating SSCs). The south header can be used for SFP makeup and for all normally supplied loads with the exception of the control air compressors.
   ii) FPS2 will be aligned to B RHRSW at the following location;
      (1) At the intake structure,
      Note: The B RHRSW can provide standby coolant to Unit 2 and/or Unit 3, if needed.
   iii) FPS3 will be aligned at the following location:
      (1) At the intake structure,
      Note : The D RHRSW can provide standby coolant to Unit 1 and/or Unit 2, if needed.
   iv) (FPS4) - (N+1), is a spare.

Based on Table 4.5.2-2 of GEH Evaluation of FLEX Implementation Guidelines (Ref. 4), Summary of Analysis Results for No Containment Venting (RCIC Suction from suppression pool) with heat input from Main Steam Relief Valves (MSRVs) and from RCIC during Phase 1,

Maintain Containment
(Section 14) BWR Portable Equipment Phase 2:

the primary containment temperature limit can be approached at around 8.8 hours. During Phase 2, FLEX deployment provides several alternatives for managing the heat load on containment.

4) Anticipatory venting of the containment, primary cooling strategy, will commence within the first 6 hours of the event with:
   a) Manual operation locally of the existing hardened wetwell vent, as currently designed .
5) Another method is to remove heat from the reactor system (reducing containment heat addition rate):
   a) Heat can be removed by running HPCI in CST to CST mode (Remove work from reactor steam heat) (If the CST is available).
      i) High Pressure Coolant Injection (HPCI) battery power is provided by chargers that are diesel backed (as noted above) in Phase 2. HPCI is not run until chargers are online.
6) Another method is to remove heat directly from containment:
   a) The Drywell Cooling system can be used with:
      i) EECW supply for RBCCW system from FLEX Pumping System, FPS1, and motive supply for fans, valves, controllers, and pumps from 480v FLEX DGs, the Spare 480v FLEX DG or the 4kv FLEX Support DGs.
7) Makeup to the suppression pool, if required during Phase 2, provided by FLEX Pumping System, FPS2 or FPS3.
   a) Spraying the drywell (and/or the wet well) may be required utilizing FLEX pumps. This is done by:
      i) Containment spray from RHRSW to RHR standby coolant crosstie, with
      ii) Residual Heat Removal Service Water (RHRSW) charging from FLEX Pumping Systems, FPS2 or FPS3, depending on unit.
      iii) Water removal from the torus, if required, driven through RHR drain pump system using containment pressure if pump not available. May also use a special HPCI lineup – Torus to CST or Hotwell, if available. The ability to accomplish this function is still under review. (Open Item, OI 20)

      Note: Spraying of the Drywell could only be performed if adequate core cooling can be insured by non-continuous injection of water to the RPV to ensure adequate core cooling. This may be difficult to satisfy, when the diesel driven FLEX pumps are the only source of RPV makeup.

RCIC may still be in service for all or part of Phase 2, especially if Torus water temperature is

Maintain Containment
(Section 14) BWR Portable Equipment Phase 2:
maintained below 240 degrees F. Additionally, a modification is planned to allow use of auxiliary cooling from raw water to supply the RCIC lube oil cooler to protect turbine bearings. Emergency procedures currently require transfer of RCIC suction supply from CST to the suppression pool, if needed, to prevent adding too much inventory to the suppression pool. Note: In order to maximize use of suppression pool water at its coolest values, procedures are being evaluated to utilize suction from the suppression pool until the temperatures rises to above 180 degrees F; and then transfer to the CST at this point, if available. The CST is not credited as being able to sustain all the events listed in Section 1; however, it would be used if available, because it provides additional margin before containment temperature is challenged, and it reduces the temperature of the RCIC bearing cooler. This plan addresses CST use because if the CST survives, its use requires consideration of the need for mass removal from the suppression pool. The least complicated means to remove water from the suppression pool is through the use of the hardened wetwell vent system, taking advantage of the water released via this vent path.
Details:

(Section 14a) Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation*
Browns Ferry Nuclear Plant will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06 (Ref. 6). These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs (Open Item, OI 17).	
(Section 14b) Identify modifications	*List modifications*
• Construct Flexible Equipment Storage Building (FESB), located above the Probable Maximum Flood (PMF) level, which is adequately protected from the hazards listed in Section 1. The storage facility(s) will be used to store support equipment and items, including the four FLEX Pumping Systems, two 480v FLEX DG's and two 4kv FLEX Support DGs. (Open Items, OI 9 and OI 10) • Provide deployment locations above the PMF for staging of the 480v FLEX DG's.	

Maintain Containment
(Section 14) BWR Portable Equipment Phase 2:
• Provide deployment path modifications, as necessary to ensure paths are reliable. • Install connection points on the "B" and "D" RHRSW piping at the Intake Structure. **"B" header provides Unit 2 & Unit 3 compliance. "D" header provides Unit 1 & Unit 2 compliance.** (Open Item, OI 9) • Install connection point on the South EECW header piping at the Intake Structure. **This header supplies support functions not directly related to mitigating strategies for core, containment and SFP cooling on Units 1, 2 & 3.** (Open Item, OI 9)

(Section 14c) Key Containment Parameters	*List instrumentation credited or recovered for this coping evaluation.*
See instrumentation listed in Phase 1 section.	
(Section 14d) Storage / Protection of Equipment : **Describe storage / protection plan or schedule to determine storage requirements**	
Seismic	*List how equipment is protected or scheduled to protect*
Portable equipment, maintained in the FESB, and connection points required to implement this FLEX strategy will be designed to meet or exceed BFNP design basis Safe Shutdown Earthquake (SSE) protection requirements.	
Flooding Note: if stored below current flood level, then ensure procedures exist to move equipment prior to exceeding flood level.	*List how equipment is protected or scheduled to protect*
Portable equipment required to implement this FLEX strategy will be maintained in the FESB, which is sited in a suitable location(s) that is above the Probable Maximum Flood (PMF) level and, as such, is not susceptible to flooding from any source. FLEX equipment deployment paths shall maintain a minimum elevation of 565', Mean Sea Level (MSL). Plant shutdown is required when flood levels reach 558' MSL in accordance with 0-AOI-100-3 (Ref. 1b). Updated Final Safety Analysis Report (UFSAR). Based on UFSAR Chapter 2.4A Figure 16 (Ref. 2ai) shows the plant has approximately 5 days from the time river level reaches 558' MSL to the time the water level would reach 565' MSL.	
Severe Storms with High Winds	*List how equipment is protected or scheduled to protect*

Maintain Containment
(Section 14) BWR Portable Equipment Phase 2:
Portable equipment required to implement this FLEX strategy will be maintained in the FESB, which is designed to meet or exceed the licensing basis high wind hazard for BFNP.

Snow, Ice, and Extreme Cold	*List how equipment is protected or scheduled to protect*

The FESB will be evaluated for snow, ice, and extreme cold temperature effects and heating will be provided as required to assure no adverse effects on the FLEX equipment. The FESB will have a stand-alone HVAC system.

High Temperatures	*List how equipment is protected or scheduled to protect*

The FESB will be evaluated for high temperature effects and ventilation will be provided as required to assure no adverse effects on the FLEX equipment. The FESB will have a stand-alone HVAC system.

(Section 14e) Deployment Conceptual Design
(Attachment 3 contains Conceptual Sketches)

Strategy	**Modifications**	**Protection of connections**
Identify strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*
Hardened Containment Vent System (HCVS) is designed as permanently installed equipment. No deployment strategy is required.	The Hardened Containment Vent System (HCVS) is currently installed in accordance with requirements of Generic Letter 89-16. A separate transmittal is being submitted to seek relaxation from the containment venting requirements of NRC Order EA-12-049, to allow compliance in accordance with the schedule for NRC Order EA-13-109.	Hardened Containment Vent System (HCVS) is designed as permanently installed equipment. No connection points are required.
FLEX Pumping Systems will be deployed as shown in Figures 3a and 3b.	Connection points will be provided within the intake pumping station at “B” and “D” RHRSW headers and the	Pump connection points are protected from the hazards for all events listed in Section 1.

Maintain Containment
(Section 14) BWR Portable Equipment Phase 2:

480v FLEX DG's will be deployed as shown in Attachment 3 Figure 3c	south EECW header. **The "B" header ensures compliance for Unit 2 and/or Unit 3. The "D" header ensures compliance for Unit 1 and/or Unit 2.** Deployment locations will be modified to be above the PMF	480 V FLEX DGs shall be protected from all events listed in section 1. The Spare FLEX DG shall be protected from all events listed in Section 1.

<u>References</u>:

1. Abnormal Operating Instructions (AOIs)
    a. 0-AOI-57-1A, Loss of Offsite Power (161 and 500 KV)/Station Blackout
    b. 0-AOI-100-3, Flood Above Elevation 558'
2. Browns Ferry Nuclear Plant (BFNP) Updated Final Safety Analysis Report (UFSAR)
    a. Section 2.4A,
        i. Figure 16 (Amendment 25)
3. Draft Interim Staff Guidance JLD-ISG-2012-01, Compliance with Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond-Design-Basis External Events"; Docket ID NRC-2012-0068
4. GEH Evaluation of FLEX Implementation Guidelines, NEDC-33771P, Revision 0
5. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"
    a. Section 7.3.1.1.b

<u>Notes:</u>

None

Maintain Containment
(Section 15) BWR Portable Equipment Phase 3:
Provide a general description of the coping strategies using Phase 3 equipment including modifications that are proposed to maintain containment integrity. Identify methods (containment vent or alternative / Hydrogen Igniters) and strategy (ies) utilized to achieve this

Maintain Containment
(Section 15) BWR Portable Equipment Phase 3:
coping time. *Primary (and Alternate) Strategy* For Phase 3, the containment cooling maintenance strategy is initially the same as the strategy being implemented in Phase 2 (containment venting via the hardened wetwell vent in accordance with existing procedures and design).: 1. Phase 3 will provide additional support to continue and reinforce the Phase 2 strategy. Phase 3 will provide (6) ~ 1 MWe Generators (2 per reactor unit), high capacity low pressure pumps with booster pump assemblies to backup FPS1, FPS2, & FPS3, additional diesel fuel, supplies and redundancy for the FLEX equipment being used. Additionally, Phase 3 will provide for demineralized water to makeup to the torus, Spent Fuel Pool (SFP), and/or the Reactor Pressure Vessel (RPV) as necessary. Eventually in Phase 3 or beyond, after the (6) 1 MWe RRC Generators arrive on site and are deployed and hooked up, RHR containment cooling modes can be made available utilizing an RHR pump with suction from the Torus, RHR Heat Exchanger cooling being provided by FPS2 and /or FPS3 and the RHR room Cooler and seal heat exchanger being supplied EECW cooling water from FPS1.
Details:

(Section 15a) Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation*
Same as Section 14a.	
(Section 15b) Identify modifications	*List modifications*
Same as Section 14b, except that additional connection points will be provided to replace any FLEX DGs that have failed. (Open Item, OI 9)	
(Section 15c) Key Containment Parameters	*List instrumentation credited or recovered for this coping evaluation.*

Maintain Containment		
(Section 15) BWR Portable Equipment Phase 3:		
Same as Section 14c.		
(Section 15d) Deployment Conceptual Design **(Attachment 3 contains Conceptual Sketches)**		
Strategy	**Modifications**	**Protection of connections**
Identify strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*
Same as Section 14d.	Same as Section 14d.	Same as Section 14d.
References: None		
Notes: None		

Maintain Spent Fuel Pool Cooling
(Section 16) Determine Baseline coping capability with installed coping[3] modifications not including FLEX modifications, utilizing methods described in Table 3-1 of NEI 12-06: • **Makeup with Portable Injection Source**
BWR Installed Equipment Phase 1:
Provide a general description of the coping strategies using installed equipment including modifications that are proposed to maintain spent fuel pool cooling. Identify methods (makeup with portable injection source) and strategy (ies) utilized to achieve this coping time. The normal Spent Fuel Pool (SFP) water inventory provides sufficient SFP cooling to prevent fuel damage for the entire coping period until Phase 2 (8 hours). RTM-96 Response Technical Manual, Volume 1 (Ref. 2), was used with a full core recently discharged plus 20 years of accumulated discharges, after 5 days shutdown. • The time for the SFP to boil is 3.1 hours. • The required makeup to offset boil off is 81 gallons per minute. • The SFP must be virtually drained for substantial damage to occur. Pools are considered coolable as long as 20% of the fuel is covered. • Cladding failure with release of the fission products in the fuel pin gap is possible within 2 hours to several days after the pool is drained. • The boil dry time is estimated at 49.3 hours. TVA will develop procedures (as shown on timeline, Attachment 1A) to deploy and secure makeup hoses at the SFP before boiling would occur. This could be required as early as 3.1 hours to avoid having to access the SFP deck while boiling is in progress; however, TVA may allow for a longer time period if actual SFP loads are lower (as would normally be expected). At eight hours into the event, more than 40 hours remain before the fuel becomes inadequately cooled. Using realistic analysis, none of the spent fuel pools at BFN currently have greater than a 3 degree per hour heatup rate immediately following fuel shuffles. Based on being at the Tech Spec limit of 150 degrees, approximately 20 hours are available for action to be taken prior to pool boil following the ELAP and LUHS. Using the administrative limit for SFP Temperature of 125 degrees, this allows approximately 30 hours for actions to be taken. (Ref. 4)

[3] Coping modifications consist of modifications installed to increase initial coping time, i.e., generators to preserve vital instruments or increase operating time on battery powered equipment.

Maintain Spent Fuel Pool Cooling	
Details:	
(Section 16a) Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation*
Browns Ferry Nuclear Plant will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06 (Ref. 1). These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs (Open Item, OI 17).	
(Section 16b) Identify modifications	*List modifications*
Modifications to install SFP level instrumentation per NRC Order EA-12-051 (Ref. 3). (Open Item, OI 12)	
(Section 16c) Key SFP Parameters	*List instrumentation credited or recovered for this coping evaluation.*
Per NRC Order EA-12-051.	

References:

1. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"
2. NUREG/BR-0150 Vol. 1, Rev. 4, "RTM-96 Response Technical Manual", Volume 1, ML003747073
   a. Table D-1. "Heatup and boil-dry times for a typical spent fuel pool"
3. "Order to Enhance Spent Fuel Pool Instrumentation", EA-12-051
4. 1-AOI-78-1, 2-AOI-78-1 & 3-AOI-78-1 Fuel Pool Cooling Cleanup System Failure

Notes:

None

Maintain Spent Fuel Pool Cooling
(Section 17) BWR Portable Equipment Phase 2:

Provide a general description of the coping strategies using on-site portable equipment including modifications that are proposed to maintain spent fuel pool cooling. Identify methods (makeup with portable injection source) and strategy (ies) utilized to achieve this coping time.

The normal Spent Fuel Pool (SFP) water inventory provides sufficient SFP cooling to prevent fuel damage for the entire Phase 1 coping period until Phase 2 (8 hours); however, Plant Staff will have deployed hoses at the refuel floor, if necessary (see Section 16), to avoid having to access the refuel deck while the SFP is boiling.

During Phase 1, plant personnel will deploy Phase 2 equipment. For flood events, the equipment is staged many hours before the peak flood waters exceed the design basis (see Attachment 1A). For other events, equipment is placed in service beginning with the SBO condition – in some cases, before an ELAP is declared (see timeline, Attachment 1A).

1) Two redundant 850kw, 480v FLEX Generators will be permanently staged in the FESB to meet N+1 requirements. They are protected for all of the extreme natural events in Section 1. These will be available during Phase 2; by connection directly to the input supply breaker to the chargers. It is currently estimated that the primary 480 FLEX Generator will be deployed and connected within 6 hours. A single DG has sufficient capacity to supply all safety related 250v battery chargers via a load control center that will be used for distribution. At this point, the Class 1 250v DC safety related battery chargers are now recovered. (Refer to Attachment 3, Figure 1)
2) Two 1.1MWe, 4kv FLEX Support Generators will be permanently staged in the FESB. It is currently estimated that these generators can be deployed within 12 hours. They would be used to energized the safety related 4kv distribution system and energize loads such as 120v ac instrumentation, ventilation, pump motors and motor operated valves.
3) Each FLEX Pumping System (FPS1, FPS2, FPS3, FPS+1) consists of a portable FLEX Low Pressure Pump (FLPP) driven by a 600 HP diesel pump rated at 5000 gpm at 150 psi discharge head and a FLEX Floating Booster Pump (FLBP). The FLBP is an integrated, transportable pumping module capable of providing up to 5,000 gpm of water at 90 ft. total dynamic head. The system utilizes two floating submersible pumps, designated “satellite pumps,” to supply water from an open source to a remote high-capacity pumping system, located as high as 50 ft. above and 150 ft. away in distance. A 300 hp diesel engine powers the hydraulic system. Two engine mounted variable displacement pumps provide pressurized hydraulic fluid to the satellite pump motors through 150 ft. hose lines. The hose lines are retrieved and stored on two hose reels driven independently by electric motors. An electronic engine management system controls and monitors the engine and provides the operator with real time supervision of all critical engine parameters and hydraulic conditions (Refer to Attachment 3, Figure 5). TVA is designing deployment locations for the pumps, including ramps, winches or other transfer assemblies as necessary to deploy all pumps and hoses within the Phase 1 coping interval. The staff begins deployment of these pumps as soon as SBO occurs rather than waiting to exhaust all attempts to restore the

Maintain Spent Fuel Pool Cooling
(Section 17) BWR Portable Equipment Phase 2:

emergency electric supply system. It is currently estimated that FPS1, FPS2 and FPS3 will be deployed and connected to provide backup RPV, SFP and Containment level addition at approximately 6, 7, and 8 hours respectively into the event. The staff begins deployment of these pumps as soon as SBO occurs rather than waiting to exhaust all attempts to restore the emergency electric supply system.

a) FLEX Pumping Systems are assigned as follows.
   i) FPS1 can be connected to one or more of the following:
      (1) Three Containment Integrated Leak Rate Test (CILRT) penetrations through Reactor Building wall, elevation 565' (4" pipe) - inside 1A, 2A, 3A RHRSW pipe tunnel, (From inside the Reactor Building, connections can be made to the Condensate Storage & Supply System and then to the vessel through RHR Loop I & II LPCI injection lines and Core Spray Loop I & II injection lines, to SFP makeup (normal), or to the Containment and Torus via their respective RHR Loop I and II flowpaths),
      (2) The EECW South header - At the intake structure (The EDGs will be isolated by manual action if needed to ensure adequate cooling to operating SSCs). The south header can be used for SFP makeup and for all normally supplied loads with the exception of the control air compressors.
   ii) FPS2 will be aligned to B RHRSW at the following location;
      (1) At the intake structure,
      Note: The B RHRSW can provide standby coolant to Unit 2 and/or Unit 3, if needed, and route water to the SFP via RHR to SFP alignment per 2-OI-74 (RHR Operating Instruction).
   iii) FPS3 will be aligned at the following location:
      (1) At the intake structure.
      Note : The D RHRSW can provide standby coolant to Unit 1 and/or Unit 2, if needed, and route water to the SFP via RHR to SFP alignment per 2-OI-74 (RHR Operating Instruction).
   iv) (FPS4) - (N+1), is a spare.

SFP level instrumentation will be provided in accordance with NRC Order EA-12-051 (Ref. 4) (Open Item, OI 12)

Primary Strategy when SFP heat load is high (early in cycle after an offload).

The fuel pool makeup requirements will be met by connecting the EECW makeup line to the SFP through the hoses previously aligned on the refuel deck. The EECW system will be charged using FLEX Pumping System, FPS1. A second alternative (N + 1) is to inject flow from FLEX Pumping System, FPS2 or FPS3 (depending on unit) via the RHR standby coolant alignment to RHR SFP makeup. . A third alternative can utilized FPS1 or FPS2 to charge the CS&S system via the 4” CILRT connections and providing makeup through the normal flow path the SFP skimmer surge tank.

Maintain Spent Fuel Pool Cooling
(Section 17) BWR Portable Equipment Phase 2:
Strategies when SFP heat load is low (late in core life) When SFP heat load is low, SFP cooling is not needed until after Phase 3 begins. If SFP makeup or cooling is needed before Phase 3, these same strategies would be implemented, only later.

(Section 17a) Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation*

Browns Ferry Nuclear Plant will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06 (Ref. 3). These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs (Open Item, OI 17).

(Section 17b) Identify modifications	*List modifications*

- Modification to install SFP level instrumentation per NRC Order EA-12-051 (Ref. 4). (Open Item, OI 12)
- FESB to store equipment (i.e., FLEX pumps, hoses, DGs, transport equipment, ramps to river, diesel fuel transfer pump systems) as described above.

(Section 17c) Key SFP Parameters	*List instrumentation credited or recovered for this coping evaluation.*

NRC Order EA-12-051, Spent Fuel Pool Level instrumentation. (Ref. 4) (Open Item 12, OI-12)

(Section 17d) Storage / Protection of Equipment :
Describe storage / protection plan or schedule to determine storage requirements

Seismic	*List how equipment is protected or scheduled to protect*

The permanent piping system used to provide water from the intake structure to the plant is the RHRSW piping which is seismically qualified. FLEX pumps will be stored in storage structures designed and constructed to meet the requirements of NEI 12-06 (Ref. 3).

Portable equipment, maintained in the FESB, and connection points required to implement this FLEX strategy will be designed to meet or exceed BFNP design basis Safe Shutdown

Maintain Spent Fuel Pool Cooling
(Section 17) BWR Portable Equipment Phase 2:
Earthquake (SSE) protection requirements.

Flooding Note: if stored below current flood level, then ensure procedures exist to move equipment prior to exceeding flood level.	*List how equipment is protected or scheduled to protect*
Portable equipment required to implement this FLEX strategy will be maintained in the FESB, which is sited in a suitable location that is above the Probable Maximum Flood (PMF) level and, as such, is not susceptible to flooding from any source. FLEX equipment deployment paths shall maintain a minimum elevation of 565', Mean Sea Level (MSL). Plant shutdown is required when flood levels reach 558' MSL in accordance with 0-AOI-100-3 (Ref. 1b). Updated Final Safety Analysis Report (UFSAR) Chapter 2.4A Figure 16 (Ref. 2ai) shows the plant has approximately 5 days from the time river level reaches 558' MSL to the time the water level would reach 565' MSL.	
Severe Storms with High Winds	*List how equipment is protected or scheduled to protect*
"The piping used to provide makeup flow to the SFP is contained within buildings that are protected from storms and high winds. Portable equipment required to implement this FLEX strategy will be maintained in the FESB, which is designed to meet or exceed the licensing basis high wind hazard for BFNP.	
Snow, Ice, and Extreme Cold	*List how equipment is protected or scheduled to protect*
The piping used to provide makeup flow to the SFP is contained within buildings that are protected from snow, ice, and extreme cold. The FESB will be evaluated for snow, ice, and extreme cold temperature effects and heating will be provided as required to assure no adverse effects on the FLEX equipment. The FESB will have a stand-alone HVAC system.	
High Temperatures	*List how equipment is protected or scheduled to protect*
The piping used to provide makeup flow to the SFP is contained within buildings that are protected from high temperatures. The FESB will be evaluated for high temperature effects and ventilation will be provided as required to assure no adverse effects on the FLEX equipment. The FESB will have a stand-alone HVAC system.	

Maintain Spent Fuel Pool Cooling		
(Section 17e) Deployment Conceptual Design **(Attachment 3 contains Conceptual Sketches)**		
Strategy	**Modifications**	**Protection of connections**
Identify strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*
Three FLEX Pumping Systems will be deployed to supply river water into existing systems**.** • FLEX Pumping System (FPS1) will be deployed to supply water into the South EECW header via installed connections at the intake pumping station**.** • FLEX Pumping System (FPS2) will be deployed to supply water into the RHRSW “B” header via installed connections at the intake pumping station. • FLEX Pumping System (FPS3) will be deployed to supply water into the RHRSW “D” header via installed connections at the	 • Install hose connections sized for FPS1 on the EECW header that will be connected to the South EECW header at the intake pumping station. • Install hose connections sized for FPS2 on the RHRSW “B” header at the intake pumping station. **“B” header provides Unit 2 & Unit 3 compliance. “D” header provides Unit 1 & Unit 2 compliance.** • Install hose connections sized for FPS3 on the RHRSW “D” header at the intake pumping station.	 • Install hose connections sized for FPS1 on the EECW header that will be connected to the South EECW header at the intake pumping station. This connection will be protected equivalent to the safety related EECW header. • Install hose connections sized for FPS2 on the RHRSW “B” header at the intake pumping station. This connection will be protected equivalent to the safety related RHRSW header • Install hose connections sized for FPS3 on the RHRSW “D” header at the intake pumping station. This connection will be protected equivalent to the safety related RHRSW header

intake pumping station. • A second arrangement would have a FLEX Pumping System supply water through the Containment Integrated Leak Rate Test (CILRT) connection in the RHRSW Tunnel 1A, running hoses in the Reactor Building to the Condensate Storage and Supply connections: which then, could be valved-in to supply water to the SPF.	 • The second arrangement through the ILRT penetration requires no modifications.	
• Portable fuel transfer pumps will remove fuel from the Emergency Diesel Generator 7-day tanks to fill equipment fuel tanks. Deployment trucks (5500 series) will also be equipped with a fuel storage tank to transport fuel to locations in need of fuel.	• Modifications may be performed to facilitate access to the Diesel Generator 7 day tanks and facilitate portable fuel transport pump connection.	Diesel generator 7-day tanks are located underneath the safety related Diesel Generators and protected from all the conditions listed in NEI 12-06, Section 1. The deployment trucks and portable fuel transfer pumps will be stored in the FESB which is protected from all the conditions listed in NEI 12-06, Section 1.

Maintain Spent Fuel Pool Cooling
References: 1. Abnormal Operating Instructions (AOIs) a. 0-AOI-57-1A, section 4.2 b. 0-AOI-100-3, Flood Above Elevation 558' 2. Browns Ferry Nuclear Plant (BFNP) Updated Final Safety Analysis Report (UFSAR) a. Section 2.4A i. Figure 16 (Amendment 25) 3. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" 4. "Order to Enhance Spent Fuel Pool Instrumentation", EA-12-051
Notes: None

Maintain Spent Fuel Pool Cooling
(Section 18) BWR Portable Equipment Phase 3:
Provide a general description of the coping strategies using Phase 3 equipment including modifications that are proposed to maintain spent fuel pool cooling. Identify methods (makeup-with portable injection source) and strategy (ies) utilized to achieve this coping time. The industry will establish two Regional Response Centers (RRC) to provide support to utilities during the beyond-design-basis events. Each RRC will hold five sets of equipment, four of which will be able to be fully deployed when requested, the fifth set will have equipment in a maintenance cycle. Equipment will be moved from an RRC to a local Assembly Area, established by the SAFER team and the utility. Communications will be established between the affected nuclear site and the SAFER team and required equipment will be moved to the site as needed. First arriving equipment, as established during development of the BFNP playbook (the Regional Response Center's plan for coordinating with each utility), will be delivered to the site within 24 hours from the initial request. The Browns Ferry Nuclear Plant Playbook will establish appropriate requirements for additional fuel and consumables to support the in-process Phase 2 strategies and will provide additional backup for extended operation of the Phase 2 strategies. In addition, the Phase 3 BFNP Playbook will include provisions for recovery facilities (i.e., demineralized water supply & (6) 1 MWe Generators). TVA is working with the Nuclear Industry to develop standard requirements for RRC response. More details regarding the BFNP Phase 3 Playbook and the Regional Response Centers will be provided in later updates (Open Item, OI 19).

Maintain Spent Fuel Pool Cooling
(Section 18) BWR Portable Equipment Phase 3:

The following Phase 2 equipment will continue to be used in Phase 3 if it is still required for spent fuel cooling.

1) Two redundant 850kw, 480v FLEX Generators will be permanently staged in the FESB to meet N+1 requirements. They are protected for all of the extreme natural events in Section 1. These will be available during Phase 2; by connection directly to the input supply breaker to the chargers. It is currently estimated that the primary 480 FLEX Generator will be deployed and connected within 6 hours. A single DG has sufficient capacity to supply all safety related 250v battery chargers via a load control center that will be used for distribution. At this point, the Class 1 250v DC safety related battery chargers are now recovered. (Refer to Attachment 3, Figure 1)
2) Two 1.1MWe, 4kv FLEX Support Generators will be permanently staged in the FESB. It is currently estimated that these generators can be deployed within 12 hours. They would be used to energized the safety related 4kv distribution system and energize loads such as 120v ac instrumentation, ventilation, pump motors and motor operated valves.
3) Each FLEX Pumping System (FPS1, FPS2, FPS3, FPS+1) consists of a portable FLEX Low Pressure Pump (FLPP) driven by a 600 HP diesel pump rated at 5000 gpm at 150 psi discharge head and a FLEX Floating Booster Pump (FLBP). The FLBP is an integrated, transportable pumping module capable of providing up to 5,000 gpm of water at 90 ft. total dynamic head. The system utilizes two floating submersible pumps, designated “satellite pumps,” to supply water from an open source to a remote high-capacity pumping system, located as high as 50 ft. above and 150 ft. away in distance. A 300 hp diesel engine powers the hydraulic system. Two engine mounted variable displacement pumps provide pressurized hydraulic fluid to the satellite pump motors through 150 ft. hose lines. The hose lines are retrieved and stored on two hose reels driven independently by electric motors. An electronic engine management system controls and monitors the engine and provides the operator with real time supervision of all critical engine parameters and hydraulic conditions (Refer to Attachment 3, Figure 5). TVA is designing deployment locations for the pumps, including ramps, winches or other transfer assemblies as necessary to deploy all pumps and hoses within the Phase 1 coping interval. The staff begins deployment of these pumps as soon as SBO occurs rather than waiting to exhaust all attempts to restore the emergency electric supply system. It is currently estimated that FPS1, FPS2 and FPS3 will be deployed and connected to provide backup RPV, SFP and Containment level addition at approximately 6, 7, and 8 hours respectively into the event. The staff begins deployment of these pumps as soon as SBO occurs rather than waiting to exhaust all attempts to restore the emergency electric supply system.
   b) FLEX Pumping Systems are assigned as follows.
      i) FPS1 can be connected to one or more of the following:
         (1) Three Containment Integrated Leak Rate Test (CILRT) penetrations through Reactor Building wall, elevation 565' (4" pipe) - inside 1A, 2A, 3A RHRSW pipe tunnel, (From inside the Reactor Building, connections can be made to the

Maintain Spent Fuel Pool Cooling
(Section 18) BWR Portable Equipment Phase 3:
Condensate Storage & Supply System and then to the vessel through RHR Loop I & II LPCI injection lines and Core Spray Loop I & II injection lines, to SFP makeup (normal), or to the Containment and Torus via their respective RHR Loop I and II flowpaths), (2) The EECW South header - At the intake structure (The EDGs will be isolated by manual action if needed to ensure adequate cooling to operating SSCs). The south header can be used for SFP makeup and for all normally supplied loads with the exception of the control air compressors. ii) FPS2 will be aligned to B RHRSW at the following location; (1) At the intake structure, Note: The B RHRSW can provide standby coolant to Unit 2 and/or Unit 3, if needed. iii) FPS3 will be aligned at the following location: (1) At the intake structure, Note : The D RHRSW can provide standby coolant to Unit 1 and/or Unit 2, if needed. iv) (FPS4) - (N+1), is a spare. SFP level instrumentation will be provided in accordance with NRC Order EA-12-051 (Ref. 3) (Open Item, OI 12) *Primary Strategy when SFP heat load is high (early in cycle after an offload).* An RHR pump, powered by FLEX generators provided by the RRC, can be aligned to SFP cooling assist mode to provide SFP cooling. Residual Heat Removal (RHR) can also provide makeup to the SFP (torus temperatures would be maintained below boiling since unit heat load will be low). Residual Heat Removal (RHR) room and seal coolers will be supported by FLEX Pumping System, FPS1 (via EECW system piping). FLEX Pumping Systems, FPS2 or FPS3 will provide river cooling supply to the RHR heat exchangers. The Fuel Pool Cooling and Cleanup (FPCCU) system can be operated with power from a FLEX DG(s) from the RRC. FLEX Pumping System, FPS1 provides cooling water for the Reactor Building Closed Cooling Water System (RBCCW) Heat Exchanger (HTX) which, in turn, supplies cooling to the FPCCU HTXs. Other strategies may be developed based on equipment supplied from the RRC (i.e., makeup pumps, demineralized water system, portable heat exchangers, and restoration of Auxiliary Decay Heat Removal System (ADHR)). If developed, these will be provided in later updates.
Schedule:

(Section 18a) Provide a brief description of	*Confirm that procedure/guidance exists or will be developed to support implementation*

<table>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3">Maintain Spent Fuel Pool Cooling</td></tr>
<tr><td colspan="3">(Section 18) BWR Portable Equipment Phase 3:</td></tr>
<tr><td>Procedures / Strategies / Guidelines</td><td colspan="2"></td></tr>
<tr><td colspan="3">Browns Ferry Nuclear Plant will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06 (Ref. 2). These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs (Open Item, OI 17).</td></tr>
<tr><td>(Section 18b) Identify modifications</td><td colspan="2">List modifications</td></tr>
<tr><td colspan="3">Modification to install SFP level instrumentation per NRC Order EA-12-051 (Ref. 3).</td></tr>
<tr><td>(Section 18c) Key SFP Parameter</td><td colspan="2">List instrumentation credited or recovered for this coping evaluation.</td></tr>
<tr><td colspan="3">SFP Level per Order EA-12-051 (Ref. 3).</td></tr>
<tr><td colspan="3">(Section 18d) Deployment Conceptual Design
(Attachment 3 contains Conceptual Sketches)</td></tr>
<tr><td>Strategy</td><td>Modifications</td><td>Protection of connections</td></tr>
<tr><td>Identify strategy including how the equipment will be deployed to the point of use.</td><td>Identify modifications</td><td>Identify how the connection is protected</td></tr>
<tr><td>See Phase 2 discussion, Section 17</td><td>See Phase 2 discussion, Section 17</td><td>See Phase 2 discussion, Section 17</td></tr>
<tr><td colspan="3"><u>References:</u>
1. Abnormal Operating Instructions (AOIs)
   a. 0-AOI-57-1A, section 4.2
2. NEI 12-06, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide”
3. “Order to Enhance Spent Fuel Pool Instrumentation”, EA-12-051</td></tr>
<tr><td colspan="3"><u>Notes:</u>
None</td></tr>
</table>

Safety Functions Support
(Section 19) Determine Baseline coping capability with installed coping[4] modifications not including FLEX modifications.
BWR Installed Equipment Phase 1
Provide a general description of the coping strategies using installed equipment including station modifications that are proposed to maintain and/or support safety functions. Identify methods and strategy (ies) utilized to achieve coping times. Main Control Room Habitability Under ELAP conditions with no mitigating actions taken, initial analysis projects the control room to approach 110°F (the assumed maximum temperature for efficient human performance) in a time of approximately 19 hours (U1/U2) and 24 hours (U3). Phase 1 FLEX strategy is to block open the entrance door to the Main Control Room (MCR) when the MCR temperature reaches 94°F (U1/U2) and 93°F (U3) (the assumed outside temperature at the time of event occurrence). This will establish a flow path for air to flow from the control building (and outside) to the MCR. The preliminary assessment indicates that by employing this strategy the MCR temperature will rise to approximately 101°F (U1/U2) and 99 °F (U3) at the 8 hour point by which time Phase 2 actions can be implemented, NEI 12-06 (Ref. 2). RCIC Room Habitability Under the Station Blackout (SBO) case the temperature remains below 127°F for the entire transient of 8 hours. To determine the temperature impact to the pump rooms over an extended period, the curves in the above assessment were extrapolated to 72 hours. The extrapolation indicated that temperature in the pump rooms will rise to a maximum of approximately 151°F in approximately 72 hours. At approximately 6 hours, FLEX pumps are available for service allowing RCIC to be shutdown, if necessary, GEH Evaluation of FLEX Implementation. Guidelines (Ref. 1) For the purposes of NEI 12-06 (Ref. 2), it is not anticipated that continuous habitability would be required in the pump rooms. If personnel entry is required into the pump room, then personal protective measures such as ice vests will be taken in accordance with Site Administrative and Safety Procedures and Processes. Other areas/rooms listed in *Loss of HVAC During ELAP* (Ref. 3) at BFNP were evaluated. The rooms selected contain equipment necessary and/or desired for coping with emergency plant functions during an ELAP condition. These areas are not anticipated to require continuous habitability and personal protective measures will be implemented in accordance with Site Administrative and Safety Procedures and Processes.

[4] Coping modifications consist of modifications installed to increase initial coping time, i.e., generators to preserve vital instruments or increase operating time on battery powered equipment.

<table>
<tr><th colspan="2">Safety Functions Support</th></tr>
<tr><th colspan="2">Details:</th></tr>
<tr><td>(Section 19a) Provide a brief description of Procedures / Strategies / Guidelines</td><td>Confirm that procedure/guidance exists or will be developed to support implementation</td></tr>
<tr><td colspan="2">Browns Ferry Nuclear Plant will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06 (Ref. 2). These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs (Open Item, OI 17).</td></tr>
<tr><td>(Section 19b) Identify modifications</td><td>List modifications</td></tr>
<tr><td colspan="2">No modifications are required to support implementation of portable equipment Phase 1. Modifications that are required will be described upon future design reviews that are controlled by the utility Standard Programs and Processes (SPPs).</td></tr>
<tr><td>(Section 19c) Key Parameter</td><td>List instrumentation credited for this coping evaluation phase.</td></tr>
<tr><td colspan="2">Battery operated portable temperature instruments are available from the BFNP tool room. These are used during normal plant operation to monitor local conditions during HVAC /chiller maintenance outages and would be available, if needed to monitor temperature in critical areas of the plant, including the MCR.

A set of required portable temperature instrumentation will be identified as required FLEX equipment and will be maintained accordingly.</td></tr>
<tr><td colspan="2"><u>References</u>:
1. “GEH Evaluation of FLEX Implementation Guidelines”, NEDC-33771P, Revision 0
2. NEI 12-06, “Diverse and Flexible Coping Strategies (FLEX) Implementation Guide”
3. Sargent and Lundy Study: “Loss of HVAC During ELAP”, Project 12938-012</td></tr>
<tr><td colspan="2"><u>Notes:</u>
None</td></tr>
</table>

Safety Functions Support
(Section 20) BWR Portable Equipment Phase 2

Provide a general description of the coping strategies using on-site portable equipment including station modifications that are proposed to maintain and/or support safety functions. Identify methods and strategy (ies) utilized to achieve coping times.

<u>Main Control Room Habitability</u>

Primary Strategy

The primary strategy for maintaining the environment of the Main Control Room (MCR) during Phase 2 will be the employment of portable fans.

- One fan blowing air at the outdoor temperature into the U1/U2 MCR 617.0-C12.
- One fan blowing air at the outdoor temperature into the U3 MCR 617.0-C19.

Temporary duct could be run from outside, through the Turbine Building, through the Corridor, and into the MCR. Power for the fans will be determined at a later date.

For the MCR areas, a breach of the Main Control Room Habitability Zone (MCRHZ) boundary and addition of temporary fans can be utilized to reduce temperatures in the MCR areas. Installation of supply and discharge flexible ductwork on the fans and locating the fans accordingly can reduce noise in the MCR areas.

<u>RCIC Room Habitability</u>

Primary Strategy

The primary strategy for maintaining the environment of the RCIC room will use the same strategy as in Phase 1, section 19. Based on extrapolation of the heat up curves, temperature in the RCIC room will rise to approximately 151°F in approximately 72 hours.

At approximately 6 hours, FPS2 and FPS3 are in service allowing RCIC to be shutdown, at which time the RCIC room will be at approximately 126°F Browns Ferry Post Fukushima FLEX Response Evaluation (Ref. 2); thus, RCIC room temperature is maintained well below equipment design limits during RCIC operations in Phase 1, Phase 2, and Phase 3.

It is not anticipated that habitability of the RCIC room will be required; however, if personnel habitability becomes necessary then personal protective measures will be implemented in accordance with Site Administrative and Safety Procedures and Processes.

<u>RHR / CS Room Habitability</u>

Under the Station Blackout (SBO) case the temperature remains below 120°F for the entire transient of 8 hours. To determine the temperature impact to the pump rooms over an extended period, the curves in the above calculation were extrapolated to 72 hours. The extrapolation indicated that temperature in the pump rooms will rise to a maximum of approximately 145°F

Safety Functions Support
(Section 20) BWR Portable Equipment Phase 2

in approximately 72 hours.

At 6 hours after the Event initiation it is assumed that the FLEX Pumping Systems are deployed for service with hoses aligned.

- “B” and “D” RHRSW headers are charged from FLEX Pumping Systems, FPS2 and FPS3.
- EECW headers charged from FLEX Pumping System, FPS1.
- Water is available on elevation 565’ of each Reactor via lines from FLEX Pumping System, FPS1.
- One spare FLEX Pumping System, FPS4, is also potentially available.

For the purposes of NEI 12-06, it is not anticipated that continuous habitability would be required in the pump rooms. If personnel entry is required into the pump room, then personal protective measures such as ice vests will be taken in accordance with Site Administrative and Safety Procedures and Processes.

<u>Engineered Safety Feature (ESF) Switchgear Rooms</u>

For Phase 2, the rooms containing the 480 VAC ESF switchgear will be begin to heat up if the switchgear is energized by a 480v FLEX DG; therefore, they were evaluated for limiting temperatures for equipment survivability. The calculations performed in *Loss of HVAC During ELAP* (Ref. 7) indicate that switchgear rooms rise to 90°F at the end of a four hour coping period. Under ELAP conditions, the units’ switchgear are de-energized at the onset of the ELAP and remain de-energized until Phase 2 when portions of the switchgear may be reenergized by the 480v FLEX DGs or the 4kv FLEX Support DGs. The rooms will begin to heat up in Phase 2, following the energization of some 480 VAC switchgear and therefore, a coping period for the duration of Phase 2 must be considered.

An acceptable strategy for heat removal from the switchgear rooms is the establishment of a method to exhaust the heat to the outside by means of portable exhaust fans. Note that the 4160 VAC switchgear is not energized during the Phase 1 coping period.

Normal air conditioning and ventilation can be restored to these rooms following the energization of the safety related electrical boards by the 4kv FLEX Support Generators.

<u>Battery Room Ventilation</u>

During battery charging operations in Phase 2 and 3, ventilation is required in the main battery rooms due to hydrogen generation. The battery rooms were evaluated for heat loads and it was determined that the resultant temperature rise is negligible, *Loss of HVAC During ELAP* (Ref. 1). The calculation of battery room hydrogen generation determined that hydrogen levels will not reach two percent until 29.9 hours assuming charging starts at time 0 and Battery room initial temperature is at 110°F with equalizing voltage at 2.33 volts *Loss of HVAC During*

Safety Functions Support
(Section 20) BWR Portable Equipment Phase 2

ELAP
(Ref. 1).

A shallow load shed can be performed that extends the Unit Battery life to no less than 12 hours with minimal load shedding. When the identified loads are shed from Unit Batteries 1, 2, and 3 it is expected that BFNP will achieve a 12 hour Unit Battery discharge duration Browns Ferry Post Fukushima FLEX Response Evaluation (Ref. 2). The batteries will be placed on charge in Phase 2 before the discharge duration runs out. (Open Item, OI 6)

Hydrogen generation does not occur unless the batteries are on charge. Phase 2 strategies can provide power both for charging and to supply power for room ventilation

There are two strategies for venting the battery rooms. The primary strategy is to prop open doors and set up portable fans. The alternate strategy is to repower the existing emergency exhaust fans which are connected to the Emergency Power bus. This will occur if the 4kv FLEX Support Generator has been connected to power the 4kv distribution system..

<u>Spent Fuel Pool Area</u>

The Spent Fuel Pool (SFP) area for BFNP is a common area for all three units. Normal HVAC is supplied from fans located on grade level on the south side of the Reactor Building. The Reactor Building Heating and Ventilating System (HVAC) is shut down and isolated when that zone of secondary containment is isolated and connected to the SGTS. For steam line failures in the Reactor Building, Updated Final Safety Analysis Report (UFSAR) Section 5-5.3 (Ref. 3b) but outside the drywell and outside the main steam valve room, the pressure would be relieved to the refueling room by the hatches and hatchways. The pressure within secondary containment would then be relieved to the large blowout panels in the insulated metal siding. Therefore, there would be no manual actions required to relieve pressure during an ELAP.

Ventilation of the refuel floor, elevation 664.0', during an ELAP can be established by opening doors to the vent tower and vent tower roof of units 1 and 3. The equipment hatches for each unit will always have a minimum opening area and allow air from the lower floors to rise and be released through the open doors to the vent tower, Updated Final Safety Analysis Report (UFSAR) Section 5-5.3 (Ref. 3a).

<u>Spent Fuel Pool Gate Seals</u>

Removable gates are provided at the transfer canal of the SFP to facilitate movement of fuel during refueling operations. The gates have non-inflatable (rubber) seals, as described in Reactor Assembly (Unit 1/3) (Ref. 4) and Reactor Vessel Disassembly and Reassembly (Ref. 5). Therefore, the SFP gate seals are not a consideration during an ELAP.

<u>Protected Area and Vital Area Access</u>

BFN Nuclear Security maintains available, a Power Independent Alternate Power source ensuring that Security attributes can be maintained during a loss of all Plant Off-Site and

Safety Functions Support
(Section 20) BWR Portable Equipment Phase 2
On-Site AC power. If Nuclear Security's alternate power source is lost, then Nuclear Security has compensatory plans ready with actions prioritized. These plans are developed to continue site protective measures and support security related elements of an emergency response, including access to Plant Vital Areas through Security Locks and management of the Protected Area Vehicle Barrier System. In addition to these security compensatory plans, FLEX procedures will be screened for security related impediments and where applicable added measures will be afforded to ensure prompt implementation of a given strategy.
Details:

(Section 20a) Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation*
Browns Ferry Nuclear Plant will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06. These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs (Open Item, OI 17).	
(Section 20b) Identify modifications	*List modifications*
No modifications are required to support implementation of Phase 2 portable equipment. Modifications that are required will be described based upon future design reviews that are controlled by the utility Standard Programs and Processes (SPPs).	
(Section 20c) Key Parameter	*List instrumentation credited for this coping evaluation phase.*
None	
(Section 20d) Storage / Protection of Equipment : Describe storage / protection plan or schedule to determine storage requirements	
Seismic	*List how equipment is protected or scheduled to protect*
Portable equipment, maintained in the FESB, and connection points required to implement this	

<table>
<tr><td colspan="3"></td></tr>
<tr><th colspan="3">Safety Functions Support</th></tr>
<tr><th colspan="3">(Section 20) BWR Portable Equipment Phase 2</th></tr>
<tr><td colspan="3">FLEX strategy will be designed to meet or exceed BFNP design basis Safe Shutdown Earthquake (SSE) protection requirements</td></tr>
<tr><td>Flooding
Note: if stored below current flood level, then ensure procedures exist to move equipment prior to exceeding flood level.</td><td colspan="2">List how equipment is protected or scheduled to protect</td></tr>
<tr><td colspan="3">Portable equipment required to implement this FLEX strategy will be maintained in the FESB, which is sited in a suitable location that is above the Probable Maximum Flood (PMF) level and, as such, is not susceptible to flooding from any source. FLEX equipment deployment paths maintain a minimum elevation of 565', Mean Sea Level (MSL). Plant shutdown is required when river level reaches 558' MSL in accordance with 0-AOI-100-3 (Ref. 1a). Updated Final Safety Analysis Report (UFSAR) Section 2.4A Figure 16 (Ref. 3ai) shows that more than 5 days will elapse in a rising flood sequence between river elevation 558' MSL and 565' MSL.</td></tr>
<tr><td>Severe Storms with High Winds</td><td colspan="2">List how equipment is protected or scheduled to protect</td></tr>
<tr><td colspan="3">Portable equipment required to implement this FLEX strategy will be maintained in the FESB, which is designed to meet or exceed the licensing basis high wind hazard for BFNP,</td></tr>
<tr><td>Snow, Ice, and Extreme Cold</td><td colspan="2">List how equipment is protected or scheduled to protect</td></tr>
<tr><td colspan="3">The FESB will be evaluated for snow, ice, and extreme cold temperature effects and heating will be provided as required to assure no adverse effects on the FLEX equipment. The FESB will have a stand-alone HVAC system.</td></tr>
<tr><td>High Temperatures</td><td colspan="2">List how equipment is protected or scheduled to protect</td></tr>
<tr><td colspan="3">The FESB will be evaluated for high temperature effects and ventilation will be provided as required to assure no adverse effects on the FLEX equipment. The FESB will have a stand-alone HVAC system.</td></tr>
<tr><th colspan="3">(Section 20e) Deployment Conceptual Design
(Attachment 3 contains Conceptual Sketches)</th></tr>
<tr><th>Strategy</th><th>Modifications</th><th>Protection of connections</th></tr>
<tr><td>Identify strategy including how the</td><td>Identify modifications</td><td>Identify how the connection is protected</td></tr>
</table>

Safety Functions Support
(Section 20) BWR Portable Equipment Phase 2

equipment will be deployed to the point of use.		
480v FLEX DGs and 4kv FLEX Support DGs will be stored in the FESB	Elevated ramps for staging areas may be necessary for flood conditions.	Portable generators will be stored in the FESB. The FESB shall be protected from all events listed in Section 1.

References:

1. Abnormal Operating Instructions (AOIs)
    a. 0-AOI-100-3, Flood Above Elevation 558'
2. AREVA Engineering Information Record Document No.: 51-9198045-000, "Browns Ferry Post Fukushima FLEX Response Evaluation"
3. Browns Ferry Nuclear Plant (BFNP) Updated Final Safety Analysis Report (UFSAR)
    a. Section 2.4A
        i. Figure 16 (Amendment 25)
    b. Section 5-5.3, 0-47E200-2 & 3-47E200-11
4. GEK-779 Volume II, GEK-9646A, "Reactor Assembly (Unit 1/3)", GEK-9646B (U2)
5. MSI-0-001-VSL001, "Reactor Vessel Disassembly and Reassembly", section 7.16
6. NEI 12-06, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide"
7. Sargent and Lundy Study: "Loss of HVAC During ELAP", Project 12938-012
8. NRC Open Item 3.2.4.5.A from the BFN Interim Safety Evaluation (ADAMS Document ML13225A541)

Notes:

None

Safety Functions Support
(Section 21) BWR Portable Equipment Phase 3
Provide a general description of the coping strategies using Phase 3 equipment including modifications that are proposed to maintain and/or support safety functions. Identify methods and strategy (ies) utilized to achieve coping times. <u>Main Control Room Habitability</u> The primary and secondary strategies for cooling the MCR are the same in Phase 3 as for Phase 2. <u>Other Support Requirements</u> Other areas of support required in Phase 3 are the same as described in the Phase 2 section of Safety Functions Support section. <u>References</u>: 1. "FLEX Implementation HVAC Analysis Impact Study", Project No. 12938-012 (Corporate) 2. "Browns Ferry Post Fukushima FLEX Response Evaluation", 91-9198045-000

Details:	
(Section 21a) Provide a brief description of Procedures / Strategies / Guidelines	*Confirm that procedure/guidance exists or will be developed to support implementation*
See Phase 2 discussion, section 20	
(Section 21a) Provide a brief description of Procedures / Strategies / Guidelines	*List modifications*
See Phase 2 discussion, section 20	
(Section 21c) Key Containment Parameters	*List instrumentation credited or recovered for this coping evaluation.*
See Phase 2 discussion, section 20	
(Section 21d) Deployment Conceptual Design **(Attachment 3 contains Conceptual Sketches)**	

Safety Functions Support		
(Section 21) BWR Portable Equipment Phase 3		
Strategy	**Modifications**	**Protection of connections**
Identify strategy including how the equipment will be deployed to the point of use.	*Identify modifications*	*Identify how the connection is protected*
See Phase 2, Safety Functions Support	See Phase 2, Safety Functions Support	See Phase 2, Safety Functions Support

References:

1. AREVA Engineering Information Record Document No.: 51-9198045-000, "Browns Ferry Post Fukushima FLEX Response Evaluation"
2. Sargent and Lundy Study: "Loss of HVAC During ELAP", Project 12938-012

Notes:

None

(Section 22) BWR Portable Equipment Phase 2							
Use and (potential / flexibility) diverse uses						*Performance Criteria (Open Item, OI 13)*	*Maintenance*
List portable equipment (1)	Core	Containment	SFP	Instrumentation	Accessibility		Maintenance / PM requirements
Four FLEX Low Pressure Pumps, FLPP	**X**	**X**	**X**			5000 gpm 150 psig	Will follow EPRI template requirements
Four Floating Booster Pumps, FLBP	**X**	**X**	**X**			5,000 gpm 50 ft lift capacity	Will follow EPRI template requirements
Two 4160 V FLEX Generators	**X**	**X**	**X**	**X**		4160v 1.1 MW	Will follow EPRI template requirements
Two 480 V FLEX Generators	**X**	**X**	**X**	**X**		480 V 850 KW	Will follow EPRI template requirements
Hoses, adapters and connectors	**X**	**X**	**X**		**X**	As required to implement strategies	Will follow EPRI template requirements
Two Diesel Transfer Pumps	**X**	**X**	**X**			200 gpm Diesel driven	Will follow EPRI template requirements
Two sets of Cables for connecting portable generators	**X**	**X**	**X**	**X**	**X**	N/A	Will follow EPRI template requirements
Six Portable ventilation fans	**X**	**X**	**X**	**X**	**X**	120V TBD, cfm as specified in design studies	Will follow EPRI template requirements
Two Tow Vehicles with bed mounted fuel tank and fuel transfer capability. (Deployment of FLEX Equipment and Fuel Transfer). These vehicles will be equipped with "scraper" blades that will be capable of snow and ice removal.	**X**	**X**	**X**	**X**	**X**	5500 series, 4wd, capable of on-site transport of 14,000 Gross Vehicle Weight (GVW) trailer and fuel transfer with 500 gallon truck bed mounted fuel tank and fuel transfer pump.	Will follow EPRI template requirements
Two Compact Track Loader – CAT 299D (XHP) or similar.					**X**		Will be equipped with a bucket, forks and a grapple.

(Section 23) BWR Portable Equipment Phase 3							
Use and (potential / flexibility) diverse uses						*Performance Criteria (Open Item, OI 13)*	*Notes*
List portable equipment	Core	Containment	SFP	Instrumentation	Accessibility		
Low Pressure FLEX Pumps	X	X	X			5000 gpm 150 psig	Will follow EPRI template requirements
Floating Booster Pumps	X	X	X			5,000 gpm 50 ft Lift 150 ft tether	Will follow EPRI template requirements
Medium Voltage Generators	X	X	X	X	X	4kv 1.1MW	Will follow EPRI template requirements
Low Voltage Generators	X	X	X	X		480 V 850 KW	Will follow EPRI template requirements
Hoses, adapters and connectors	X	X	X		X	As required to implement strategies	Will follow EPRI template requirements
Diesel Transfer Pumps	X	X	X	X		200 gpm	Will follow EPRI template requirements
Portable ventilation fans	X	X	X	X		5,000 cfm	Will follow EPRI template requirements
480 V Air Compressors	X	X	X			200 cfm 100 psig	Will follow EPRI template requirements
Mobile Water Purification Unit	X	X	X			Capacity TBD, Reseverse Osmosis	Will follow EPRI template requirements

(Section 24) Phase 3 Response Equipment/Commodities	
Item	**Notes**
Radiation Protection Equipment • Survey instruments • Dosimetry • Off-site monitoring/sampling • Radiological counting equipment • Radiation protection supplies • Equipment decontamination supplies • Respiratory protection	**Existing Radiation Protection equipment is adequate to address expected conditions during an event**
Commodities • Food • Meals Ready to Eat (MRE) • Microwavable Meals • Potable water • Sanitation	**Each site will maintain MREs, potable water and sanitation supplies to accommodate the intended site complement of personnel for a minimum of 7 days**
Fuel Requirements • Diesel Fuel • Diesel Fuel Bladders	**An adequate site fuel supply and strategy exists. Fuel bladders will be delivered via the Regional Response Center**
Heavy Equipment • Transportation equipment • 4 wheel drive tow vehicle • Debris clearing equipment	**The current strategy includes a 4 wheel drive equipment tow vehicles, various trailers for transporting supporting equipment, and multiple compact track type loaders for debris removal.**
Communications Equipment • Satellite Phones • Portable Radios	**Satellite phones have been purchased and issued to each site. Portable radios already exist at each site**
Portable Interior Lighting • Flashlights • Headlamps • Batteries	**Provisions have been included in the strategies to store personnel lighting and batteries in a protected facility**
Portable Exterior Lighting • Light units with diesel generator	**Strategies include provisions and protection for battery powered light stands with additional diesel driven light units delivered from the Regional Response Center**
Personnel equipment • Tools • Gloves, etc.	**Strategies include hand tools as part of the protective facility storage items. These include chain saws, rigging equipment and personnel protective equipment including arc flash protection equipment**

LIST OF ATTACHMENTS
INDEX

Attachment 1A, Sequence of Events Timeline

Action item	Elapsed Time	Action	Time Constraint Y/N [5]	Remarks / Applicability
1	T- ~198 hours	For floods, plant shutdown begins when river level reaches 558' and it is predicted that level will exceed 565’, per procedure AOI-100-3. FLEX deployment begins.	N	Plant meets required shutdown criteria approximately 190+ hours before design basis peak flood level is reached (for FLEX, this is assumed to be exceeded).
2	T -186 hours	For Floods, the plant is now is in cold shutdown.	N	
3	T-72 hours	Flood waters reach plant grade level, FLEX pumps and portable generators (4kv and 480v) deployment must be complete.	Y	Based on design basis flood. Because the there is sufficient warning time for this condition, extra resources will be available and this time constraint will be readily achieved.
4	T-0	This is the point at which a DBF level would be reached.	N/A	For information only

[5] Instructions: Provide justification if No or NA is selected in the remarks column. If yes, include technical basis discussion as required by NEI 12-06 section 3.2.1.7

Attachment 1A, Sequence of Events Timeline

Action item	Elapsed Time	Action	Time Constraint Y/N [5]	Remarks / Applicability
5	T-0	All offsite power, and normal access to the ultimate heat sink is lost - **Phase 1 Commences**	N/A	All 3 units are assumed to have been operating at 100 percent rated thermal power for at least 100 days or have just been shut down from such a power history as required by plant procedures in advance of the impending event. For floods, FLEX deployment would have already been complete and the units would be at cold shutdown. For information only.
6	T< 5 secs	MSIVs isolate (for events where plant is initially in Mode 1).	N/A	Design basis response to loss of offsite power. For information only.
7	T+30 secs	High Pressure Coolant Injection (HPCI) and RCIC achieve full flow. After HPCI and RCIC recover RPV level, HPCI will be secured and RCIC will be the primary system for RPV level control. When HPCI is secured, Operators will be directed (a change to the SBO procedure to shift HPCI suction to the suppression pool from the MCR.	N/A	Design basis - Event initiated based on preliminary estimates (and assumed that these valves are not operated after the first hour to maintain battery life for 12 hours (Open Item, OI 6). Response to loss of offsite power.
8	T + 20 minutes	RPV depressurization starts at 20 minutes by a rate of 90°F/hr, unless the EOI's permit a rate of 100°F/hr.	Y	Requirement of Abnormal Operating Instruction for SBO, 0-100-AOI-3 and EOI-1, RPV Pressure Control. Operators are effectively trained to carry out this action with minimal operator action.

Attachment 1A, Sequence of Events Timeline

Action item	Elapsed Time	Action	Time Constraint Y/N [5]	Remarks / Applicability
9	T<1 hours	Dispatch personnel to start deployment of the applicable FLEX Pumping Systems (Note: the FLEX Pumping Systems will have already been deployed for a flood event (see Item 2). Direction to deploy the FLEX Pumping Systems will be contained in site procedures.	N	FLEX Pumping Systems should be available for service by T+6 hours.
10	T<1 hours	Dispatch personnel to start deployment of the 480v FLEX DG. (Note: the 480v FLEX DG will have already been deployed for a flood event (see Item 2). Direction to deploy the 480v FLEX generators will be contained in site procedures.	N	480v FLEX DG should be available for service by T+7 hours.
11	T≤1 hour	FLEX procedures are entered. Cooldown is continued to a final pressure of approximately 150 psig – 250 psig. (Cooldown will be complete for flood events)	Y	New EPG Rev. 3 when steam driven equipment is neeed to ensure adeqyate core cooling. (TVA will determine if and when manual actions are required to support continued use of Main Steam Relief Valves (MSRVs.)) Operators are effectively trained to carry out this action with minimal operator action.
12	T+< 1 hours	Commence load shedding of non-essential vital DC loads.	N	Must be performed prior to T+4 hours to extend vital battery life to T+8 hours
13	T+>2 hours	Unit is being maintained above 150 psig, but as low as reasonably achievable (having started a cooldown depressurization at item 8).	N	New procedure guidance based on analysis not to emergency depressurize when RCIC is the only vessel makeup

Attachment 1A, Sequence of Events Timeline

Action item	Elapsed Time	Action	Time Constraint Y/N [5]	Remarks / Applicability
14	T≤4 hours	DC load shedding of vital DC loads must be complete.	Y	Battery life is now extended toT+8 hours. This action is performed on equipment in close proximity to each other and will be adequately labeled to allow easy identification.
15	T<6 hours	Anticipatory venting of the containment via the Torus hardened vent will commence. Preliminary MAAP analysis indicates that Torus temperature will be maintained <240 degrees and Containment pressure will peak at <35 psig for BFN, for a single unit only. TVA expects to transmit a request for relaxation of full compliance with NRC Order EA-12-049 until a severe accident capable vent is fully installed in accordance with NRC Order EA-13-109 is implemented for BFN, Units 2 and 3. BFN Unit will reach full compliance with EA-12-049 and EA-13-109 within the same schedule timeframe.	Y	Preliminary MAAP analysis for a single unit indicates that Torus temperature will be maintained <240 degrees and Containment pressure will peak at <35. Requires minimal operator action.
16	T≤6 hours	480v FLEX generator is deployed and connected to the safety related battery charger for each unit. Battery charging commences.	Y	Pre-staging of cable and equipment to allow connection to the charger will be performed. Further verification of this time constraint will be performed when equipment is onsite.

Attachment 1A, Sequence of Events Timeline

Action item	Elapsed Time	Action	Time Constraint Y/N [5]	Remarks / Applicability
17	T+6 hours	FLEX Pumping Systems are deployed for service with hoses aligned to provide RPV & SFP cooling.	Y	FLEX Pumps should be available prior to reaching 240 degrees Torus water temperature, in case RCIC operation becomes unreliable or unavailable. Based on training and testing performed with these pumps by TVA personnel this is the current best estimate. Further verification will be performed when the augmented suction lift pumps arrive onsite.
18	T+7 hours	EECW aligned to RCIC oil cooler (requires modification) before temperature of the suppression pool is in far excess of 240 degrees F. EECW is supplied by FPS1.	Y	Time to exceed 240 degrees F comes from initial MAAP analysis runs. Based on having FPS in service and aligned at T+6 hours, an additional hour to align the cooler has been deemed sufficient. As the DCN is further developed and more MAAP cases are run, this time may change.
19	T+7 hours	• Transition to Phase 2 of FLEX implementation for RPV level control may commence. • Once low pressure injection is available via the FLEX Pumping System, RCIC may be removed from service as deemed appropriate, based on plant conditions. MSRV's (or HPCI) would be utilized to depressurize the RPV.	N	Symptom based time limit.

Attachment 1A, Sequence of Events Timeline

Action item	Elapsed Time	Action	Time Constraint Y/N [5]	Remarks / Applicability
20	T≥12 hours	4kv FLEX Support Diesel Generators are deployed and connected. The 4kv safety related distribution system is available for service. (This time may change as DCN work progresses and connection strategy is verified)	N	They would be used to energized the safety related 4kv distribution system and energize loads such as 120v ac instrumentation, ventilation, pump motors and motor operated valves.
21	T+12 - 72 hours	Sustain coping by maintaining diesel equipment fueled and in service	N	NEI 12-06 section 3.2.1.7 applicable.
22	T+>20 hours	Add water as required to the SFP from the river using FLEX Pumping System(s), as required.	Y	Time critical at water level based on time to boil, beginning at the Tech Spec limit of 150 degrees. Based on training and testing performed with these pumps by TVA personnel this is the current best estimate. Further verification will be performed when the augmented suction lift pumps arrive onsite.
23	T+24 – 72 hours	FLEX equipment will arrive from the RRC and will be stored at staging area "B"	N	Adequate coping capability exists without supplementation from the RRC. The FLEX equipment received from the RRC will aid in recovery and provide equipment reliability.

Action item	Elapsed Time	Action	Time Constraint Y/N [5]	Remarks / Applicability
24	T + 24 hours	Manual actions to prevent excessive hydrogen accumulation in battery rooms if ventilation is not restored.	Y	The calculation of battery room hydrogen generation determined that hydrogen levels will not reach 2% until 29.9 hours (Open Item, OI 6). Adequate resources will be available during this timeframe to supplement the onsite resources.
25	T+24 hours	Manual actions to restore ventilation (if normal ventilation is not restored) by opening doors, portable fans, etc (Open Item, OI 13).	Y	Adequate resources will be available during this timeframe to supplement the onsite resources.

Attachment 1B
NSS Significant Reference Analysis Deviation Table
NEDC 33771P, GEH Evaluation of
FLEX Implementation Guidelines

Item	Parameter of interest	NEDC value (NEDC 33771P Revision 0, December 2012)	NEDC page	Plant applied value	Gap and discussion
	Suppression Pool **Temperature**	86 °F	17	95 °F	1
	Vent size	12”	D9, D8, 43, 44,	14”	2

Gaps and Discussion:

1. The thermal hydraulic analysis for the BFNP suppression pool shall be based on an initial temperature of 95°F (BFN TS limit).

2. The existing BFNP HCVS system is a 14” nominal pipe diameter. The existing configuration has a documented analysis based on vent size.

Attachment 2
Milestones

Activity	Original Target Date	Activity Status	Revised Target Completion Date
Submit Overall Integrated Plan	February 2013	Complete	
Submit 6 Month Updates:			
Update 1	August 2013	Complete	
Update 2	February 2014	Complete	
Update 3	August 2014	Complete	
Update 4	February 2015	Not Started	
Update 5	August 2015	Not Started	
Update 6	February 2016	Not Started	
Update 7	August 2016	Not Started	
FLEX Strategy Evaluation	March 2014	Complete	
Unit 1 - Validation of connection points for FLEX Phase 2 & 3 via walkthrough or demonstration. (Graded approach)	November 2016	Not Started	
Unit 2 - Validation of connection points for FLEX Phase 2 & 3 via walkthrough or demonstration. (Graded approach)	April 2015	Not Started	
Unit 3 - Validation of connection points for FLEX Phase 2 & 3 via walkthrough or demonstration. (Graded approach)	April 2016	Not Started	
Perform Staffing Analysis	January 2015	Not Started	December 2014
Modifications:			
Modifications Evaluation	March 2014	Complete	
Unit 1 N-1 Walkdown	October 2014	Not Started	
Unit 1 Design Engineering	November 2014	Started	
Unit 1 Implementation Outage	October 2016	Not Started	November 2016
Unit 2 N-1 Walkdown	March 2013	Complete	
Unit 2 Design Engineering	November 2014	Started	
Unit 2 Implementation Outage	April 2015	Not Started	
Unit 3 N-1 Walkdown	March 2014	Complete	
Unit 3 Design Engineering	November 2014	Started	
Unit 3 Implementation Outage	March 2016	Not Started	April 2016

Attachment 2
Milestones

Activity	Original Target Date	Activity Status	Revised Target Completion Date
Storage:			
Storage Design Engineering	August 2014	Complete	
Storage Implementation	November 2015	Started	April 2015
FLEX Equipment:			
Procure On-Site Equipment	January 2015	Started	
Develop Strategies with RRC	June 2014	Started	January 2015
Install Off-Site Delivery Station	May 2015	Started	April 2015
Procedures:			
BWROG issues FSG guidelines	April 2014	Complete	
Create Browns Ferry FSGs	March 2015	Started	April 2015
Create Maintenance Procedures	March 2015	Not Started	April 2015
Training:			
Develop Training Plan	September 2014	Not Started	January 2015
Implement Training	January 2015	Not Started	February 2015
Unit 1 FLEX Implementation	November 2016	Not Started	
Unit 2 FLEX Implementation	May 2015	Not Started	April 2015
Unit 3 FLEX Implementation	April 2016	Not Started	
Full Site FLEX Implementation	November 2016	Not Started	
Submit Completion Report	December 2016	Not Started	

Attachment 3
Conceptual Sketches

Index

Attachment 3
Conceptual Sketches

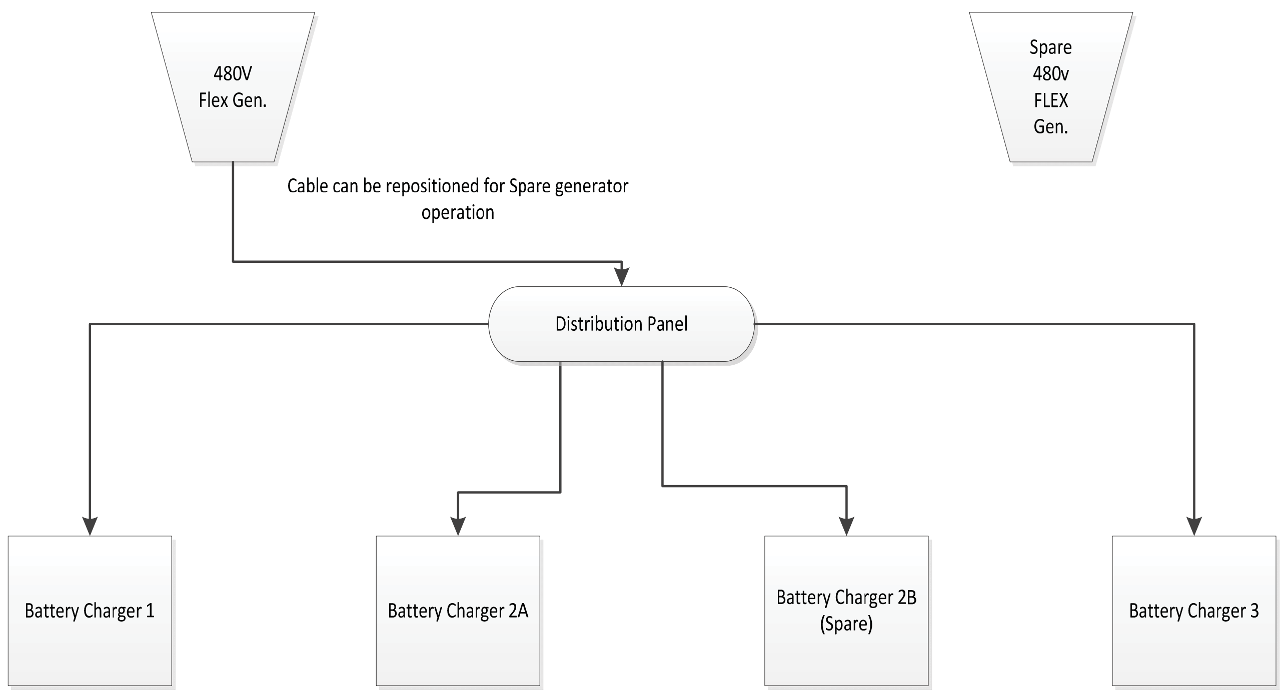


Figure 1A -Simplified Electrical Diagram for 480v FLEX Generator Strategy (still under evaluation)

Attachment 3
Conceptual Sketches

Emergency Diesel Generator output cables (Plant safety related DG's). Conceptual, other connection options are being evaluated.

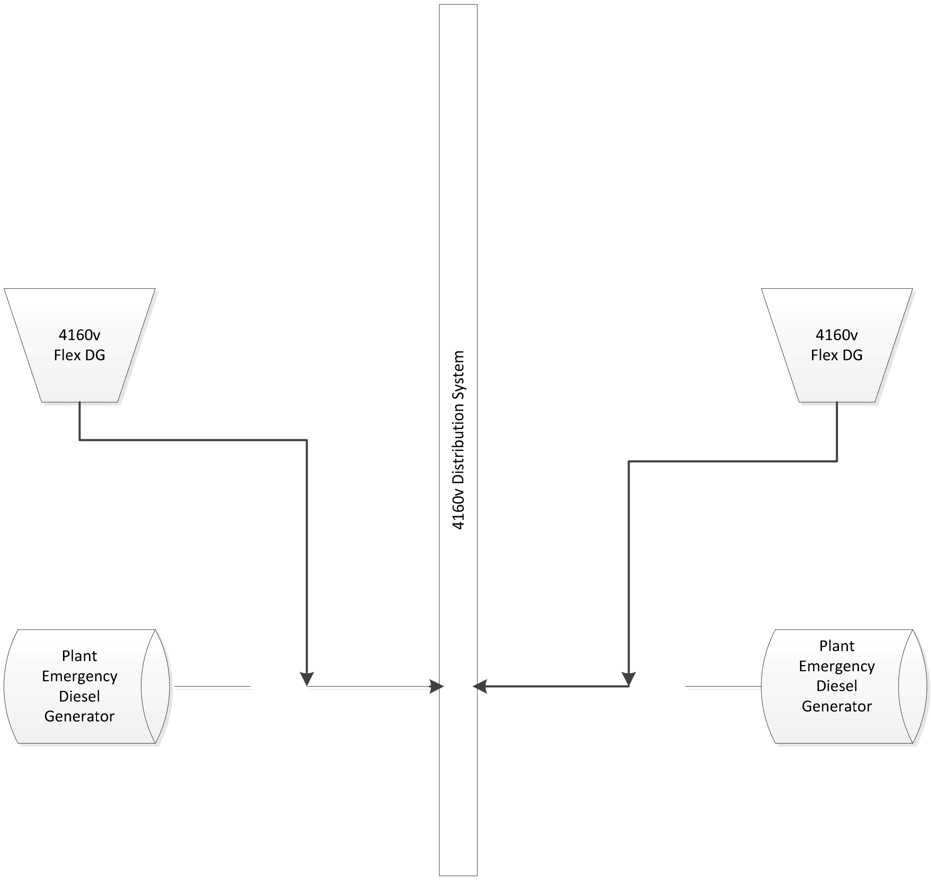


Figure 1B -Simplified Electrical Diagram for 4160v FLEX Support Generator Strategy (Still under evaluation)

Attachment 3
Conceptual Sketches

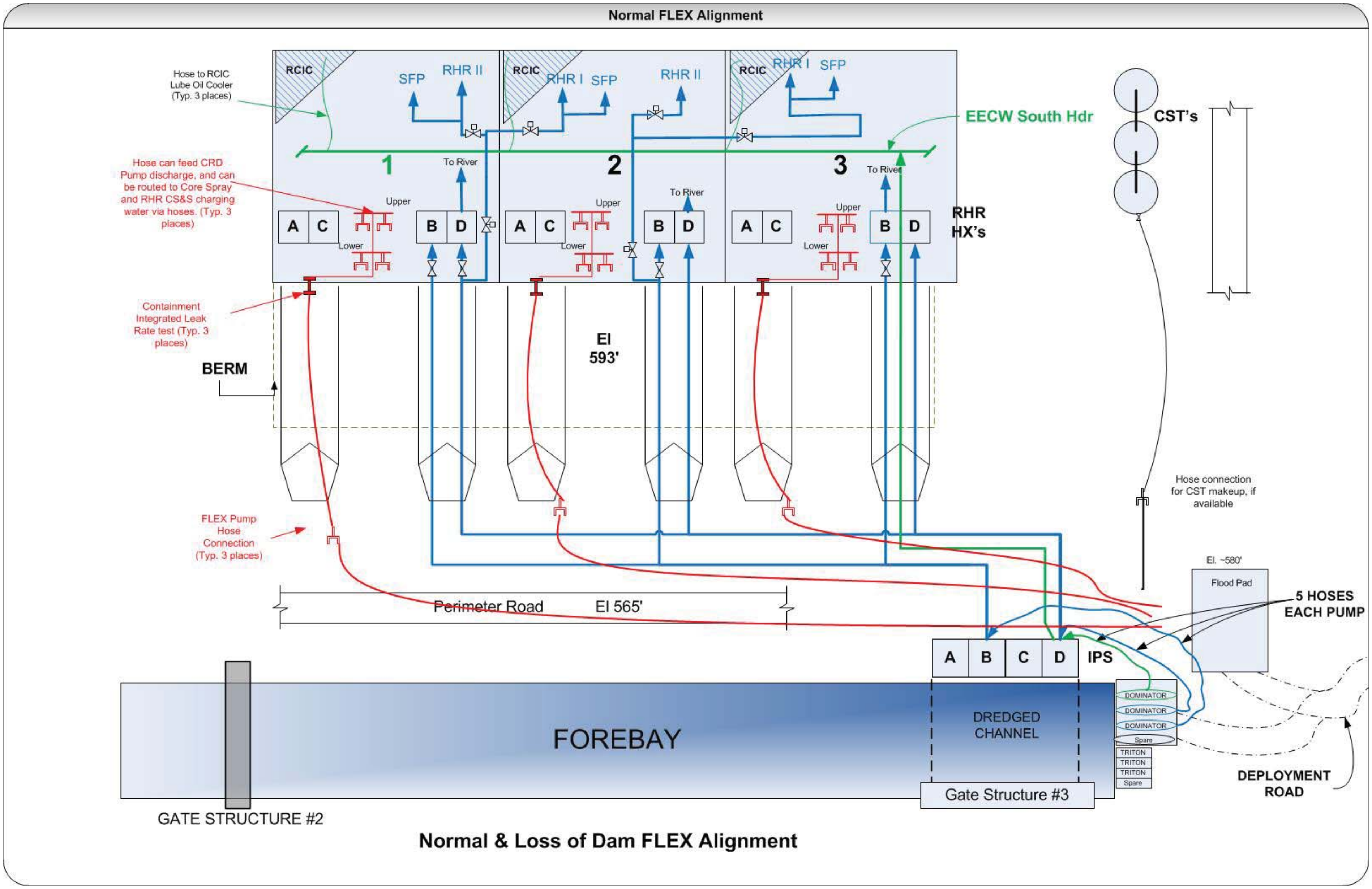


Figure 2A FLEX Pump Deployment for Normal Level or Loss of Dam

Attachment 3
Conceptual Sketches

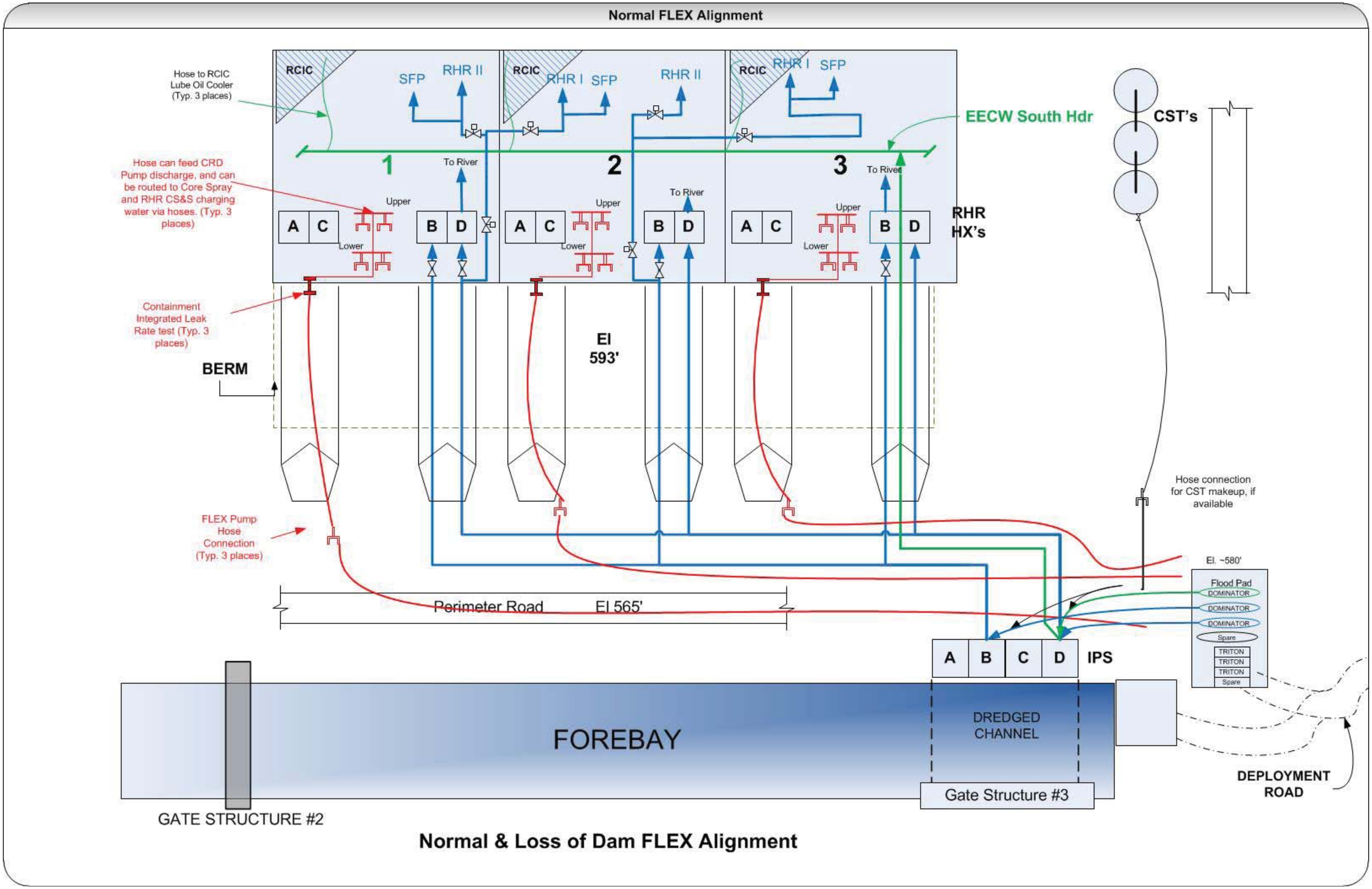
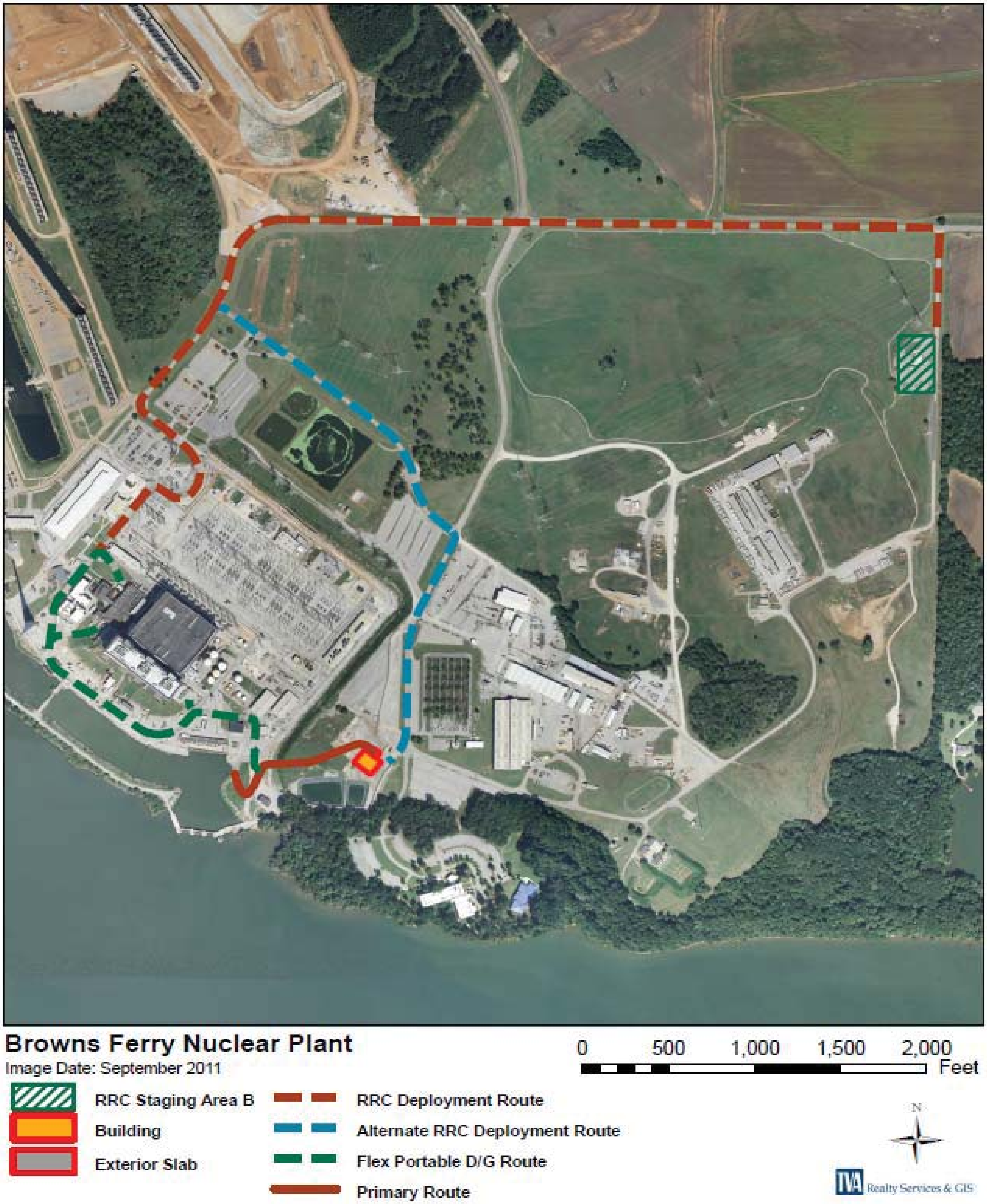


Figure 2B FLEX Pump Deployment for Flood Mode

Attachment 3
Conceptual Sketches

Figure 3A - Deployment routes for FLEX equipment



Attachment 3
Conceptual Sketches

Attachment 3 Conceptual Sketches

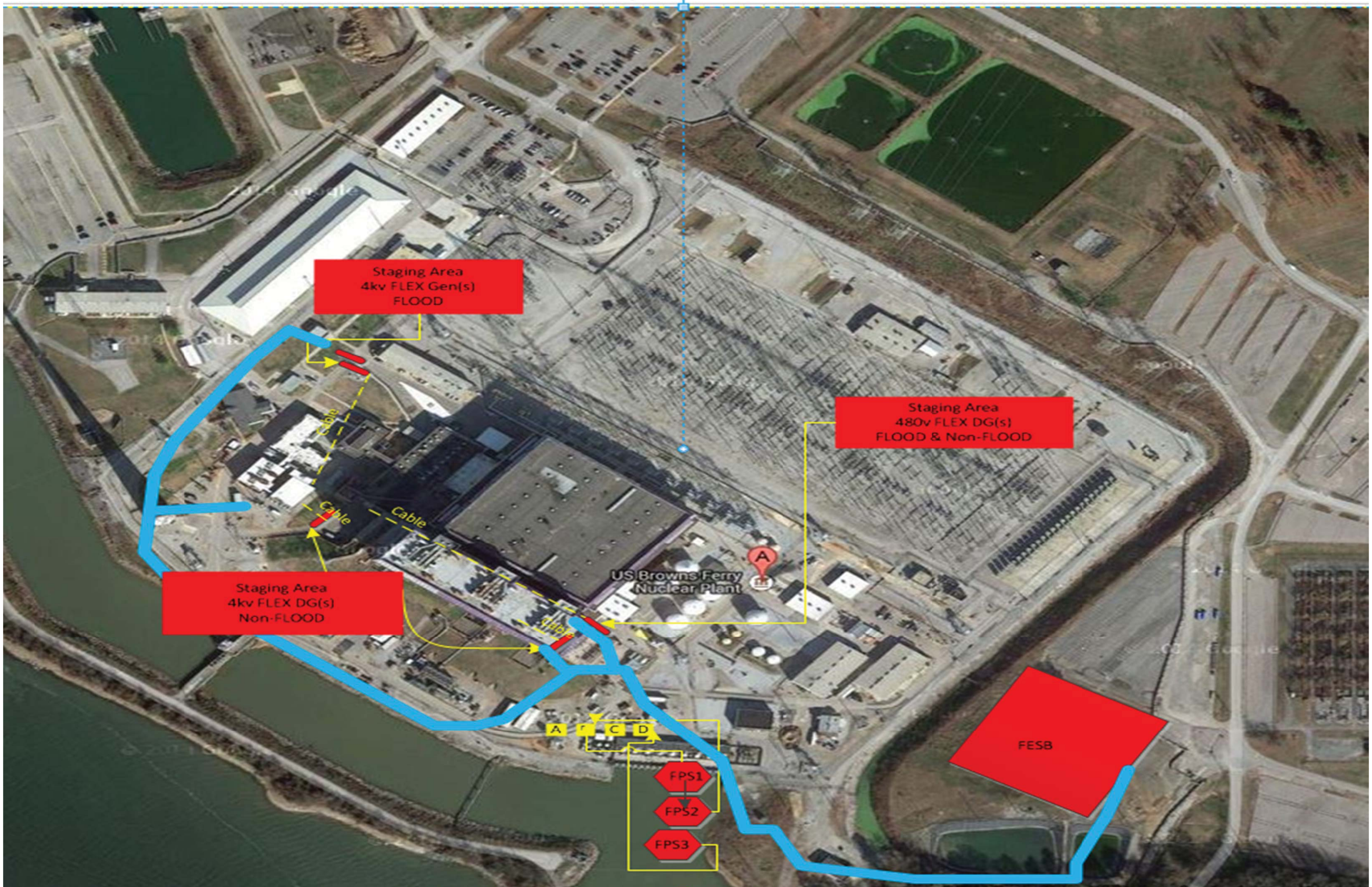


Figure 3B – FLEX Deployment Overview

Attachment 3
Conceptual Sketches

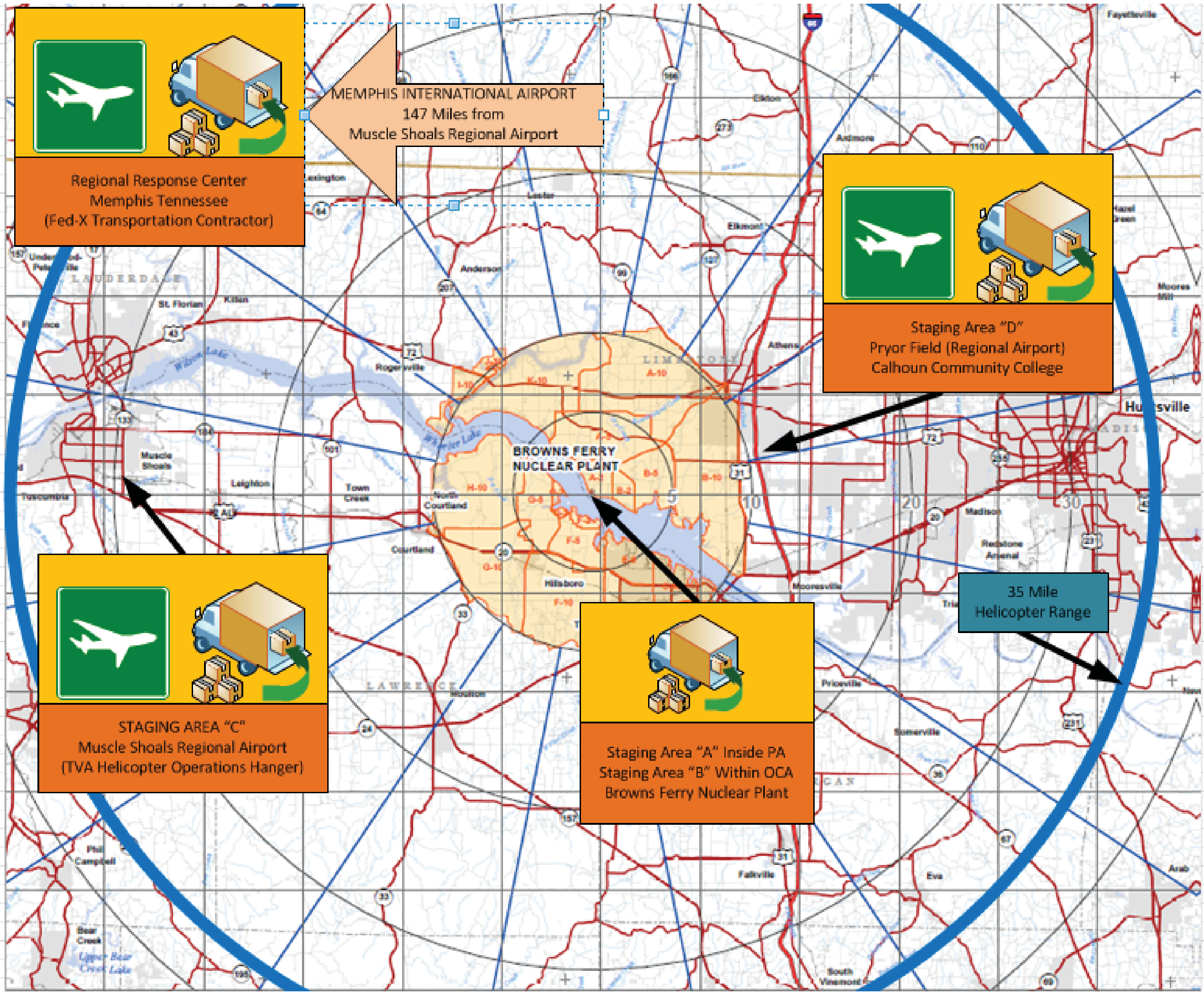


Figure 4 – Overview of RRC Deployment Paths

Attachment 3
Conceptual Sketches

Figure 5 – FLEX Pumping System (Information Only – These are vendor photos)

Attachment 4
List of Acronyms and Equipment Designators

AOI	Abnormal Operating Instruction
AOV	Air Operated Valve
ADS	Automatic Depressurization System
BDBEE	Beyond-Design-Basis External Events
BDBF	Beyond-Design-Basis Flood
BWR	Boiling Water Reactor
BWROG	BWR Owners Group
CILRT	Containment Integrated Leak Rate Test
CIV	Containment Isolation Valve
CRD	Control Rod Drive
CS	Core Spray
CST	Condensate Storage Tank
DBE	Design Basis Earthquake / Design Baseline Evaluation
DBF	Design Basis Flood
DG	Diesel Generator
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EECW	Emergency Equipment Cooling Water
ELAP	Extended Loss of AC Power
EOI	Emergency Operating Instruction
EOP	Emergency Operating Procedure
EPG	BWROG Emergency Procedure Guideline
FESB	Flexible Equipment Storage Building
FLEX	Flexible and Diverse Coping Mitigation Strategies
FPCCU	Fuel Pool Cooling and Cleanup System
FSAR	Final Safety Analysis Report
FSG	Flex Support Guidelines
GEH	GE Hitachi
HCTL	Heat Capacity Temperature Limit (for Torus/Suppression Pool)
HCVS	Hardened Containment Vent System
HPCI	High Pressure Coolant Injection
HTX	Heat Exchanger
HVAC	Heating Ventilation Air Conditioning
ICS	Integrated Computer System
ILRT	Integrated Leak Rate Test
kVA	KiloVolt-Ampere
LUHS	Loss of Ultimate Heat Sink
MAAP	Modular Accident Analysis Program
MCR	Main Control Room
MCRHZ	Main Control Room Habitability Zone
MELB	Moderate Energy Line Break
MRE	Meals Ready to Eat
MSL	Mean Sea Level

Attachment 4
List of Acronyms and Equipment Designators

MSRV	Main Steam Relief Valve
NEI	Nuclear Energy Institute
NPSH	Net Positive Suction Head
OBE	Operating Basis Earthquake
OPS	Operations Department
PMF	Probable Maximum Flood
PCP-lim	Primary Containment Pressure Limit
PSP	Pressure Suppression Pressure (function of Primary Containment Water Level)
PWR	Pressurized Water Reactor
RBCCW	Reactor Building Closed Cooling Water
RCIC	Reactor Core Isolation Cooling
RHR	Residual Heat Removal
RHRSW	RHR Service Water
RHVS	Reliable Hardened Vent System
RPV	Reactor Pressure Vessel
RRC	Regional Response Center
RWCU	Reactor Water Clean Up
SAFER	Strategic Alliance for FLEX Emergency Response
SBO	Station Blackout
SFP	Spent Fuel Pool
SGTS	Standby Gas Treatment System
SHEX	SUPERHEX computer code
SOV	Solenoid Operated Valve
SRV	Safety Relief Valve
SSC	System, Structure, or Component
SSE	Safe Shutdown Earthquake
UFSAR	Updated Final Safety Analysis Report
UHS	Ultimate Heat Sink

Equipment Designators

Diesel Generators	
FMDG – FLEX Medium Voltage Generator (FMDG1 and FMDG2)	4160 V FLEX 1.1 MW air cooled, turbine powered Generators
FLDG – FLEX Low Voltage Generator (FLDG1 and FLDG2)	480 V FLEX 850 KW air cooled, turbine powered Generators
Pumps, if written in strategy as deployed/used	
FPS – FLEX Pumping System (FPS1/2/3/4)	FLEX low pressure diesel driven pumps + Flex floating booster pumps
FLPP1, FLPP2, FLPP3, FLPP4	FLEX low pressure pump
FLBP1, FLBP2, FLBP3, FLPB4	FLEX floating booster pump

Attachment 5
List of Open Items

1. Flood and seismic re-evaluations pursuant to the 10 CFR 50.54(f) letter of March 12, 2012 are not completed and therefore not assumed in this submittal. As the re-evaluations are completed, appropriate issues will be entered into the corrective action system and addressed

2. Liquefaction of haul routes for FLEX will be analyzed from Staging Area B to Staging Area A. Also, an evaluation will be conducted of haul routes from Staging Area D and Staging Area C to Staging Area B.

3. TVA will confirm that they have enough fuel onsite for the first 24 hours. A diesel fuel storage and refueling plan also has to be developed.

4. BFNP will evaluate MSRV qualification against the predicted containment response with FLEX implementation to ensure there will be sufficient DC bus voltage and pneumatic pressure to operate the MSRVs throughout Phase 1 and Phase 2.

   Closed - Based on data contained within BFN EQ Binder, BFNEQ-SOL-009 D4, which demonstrated that MRSV Solenoid & Air Assembly can operate at temperatures $\leq$ 340 degrees F, operating pressure at least 45 psig > than containment pressure and DC voltage in the range of 212 to 276 vDC.

5. A reference source for the plant operators will be developed that provides approaches to obtaining necessary instrument readings to support the implementation of the coping strategy (NE 12-06, Section 3.2.1.1 0). This reference source should include control room and non-control room readouts and should also provide guidance on how and where to measure key instrument readings at containment penetrations, where applicable, using a portable instrument (e.g., a Fluke meter). Such a resource could be provided as an attachment to the plant procedures/guidance. Guidance will include critical actions to perform until alternate indications can be connected and on how to control critical equipment without associated control power.

6. Validate the preliminary Battery studies that were performed to ensure appropriate battery life will be available with regards to the overall FLEX strategies. Ensure that buildup of hydrogen is considered and mitigated appropriately.

7. BFNP will take actions as necessary to assure RCIC can operate at elevated temperatures.

8. Perform modifications, as necessary, to ensure that RCIC is seismically robust.

9. Develop and perform the design modifications identified in the FLEX strategy document to permit the timely and safe connection of the FLEX and RRC equipment during the adverse conditions encountered during these beyond-design-basis events.

10. Design and construct a Flexible Equipment Storage Building, located above the probable maximum flood level, which is adequately protected from the hazards listed in Section 1.

Attachment 5
List of Open Items

The storage facility(s) will be used to store support equipment and items, including the four FLEX Pumping Systems.

11. Modify currently installed hardened wetwell vent to install backup pneumatic supply or provided procedural guidance for manual operation, to allow use within current design limits.

12. Design and install the modifications required by Order EA-12-051 for enhancing the SFP.

13. Determine the design specifications for FLEX equipment yet to be ordered, such as the Six Portable ventilation fans, the Mobile Water Purification Unit, debris removal equipment for the FLEX Equipment Haul path and piping for the FLEX low pressure pumps.

14. Deployment strategies and deployment routes will be assessed for impact due to identified hazards and guidance developed/provided to ensure that 1) sufficient area is available for deployment, 2) haul paths remain accessible without interference from outage equipment during refueling outages and 3) deployment locations for the pumps, including ramps, winches or other transfer assemblies, as appropriate to deploy all pumps and hoses within the 8 hour Phase 1 coping interval.

15. Detailed staffing studies based on the procedures/guidance developed.

16. Validation of the time lines for the various strategies.

17. Browns Ferry Nuclear Plant (BFNP) will utilize the industry developed guidance from the Owners Groups, EPRI and NEI Task team to develop site specific procedures or guidelines to address the criteria in NEI 12-06. These procedures and/or guidelines will support the existing symptom based command and control strategies in the current EOIs.

18. New training of general station staff and EP will be performed prior to the first BFNP unit design implementation outage. These programs and controls will be implemented in accordance with the Systematic Approach to Training.

19. TVA will establish a contract with the Strategic Alliance for FLEX Emergency Response (SAFER) team. A local assembly area must also be established by SAFER and TVA for equipment moved from the Regional Response Center (RRC) to BFNP.

    Closure: Open Item should be closed. Refer to Section 9 of the OIP. Reference AREVA NP Inc., Engineering Information Record, Document No.: 51 - 9213690 – 001, SAFER Response Plan Master Templates

20. Evaluate different strategies to allow removal of water from the Suppression Pool. Determine if any modifications are required and what strategies are deemed feasible.

Attachment 5
List of Open Items

21. Abnormal operating procedure, AOI-100-9, Turbine Building Internal Flooding, provides the symptoms and operator actions to be taken for this condition. During development of procedures to support FLEX strategies, adequate guidance will be given to operators to ensure their travel paths avoid these areas.